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Contents.

	PAGE
Pre-Exhibition Notions	385
Correspondence	386
American Cast Pipe Makers Merge Interests	386
Gasses in Metals	386
Refractories in the Foundry	387
New Magnetic Separator for Feebly-Magnetic Materials	392
The Moulding of Grooved Pulleys	393
Patent Specifications Accepted	395
The Iron and Steel Institute	396
A Quick Testing Method for Cast Iron	398
Melting Practice in the Iron Foundry, with Special Reference to the Shaft Furnace	399
Discussion on Mr. R. W. Kemlo's Paper on "Pattern-making and its Relation to Design and Foundry Practice"	400
Estimating Weights and Waste of Time	401
Standardisation in Drawing Office and Pattern Shop	401
Trade Talk	402
Personal	402
Contracts Open	402
New Companies	402
Iron and Steel Markets	404

Forthcoming Events.

JUNE 8.
Manchester Geological and Mining Society:—Ordinary meeting at Manchester.

JUNE 10-19.
International Foundry Trades' Exhibition:—Royal Agricultural Hall, London, N.1.

JUNE 19-26.
South Wales Institute of Engineers:—Summer meeting in North Wales.

JUNE 21-23.
Institution of Heating and Ventilating Engineers:—Summer meeting at Scarborough.

JUNE 23-25.
Newcomen Society:—Summer meeting at Norwich.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Pre-Exhibition Notions.

No less than 150 foreigners are definitely known to be attending the forthcoming Exhibition which opens next Thursday at the Royal Agricultural Hall. It is thus pertinent for British foundrymen to ask themselves whether factors analogous to those animating the foreigner are also existent domestically. Obviously, only those foreigners with an almost colloquial knowledge of English can reap the maximum benefit. Is this advantage to be lost to the thousands of foundries dotted about Great Britain?

Some of these foreign foundrymen are bringing their managers and foremen with them. They realise the benefits of viewing a material or apparatus from more than one angle. This simple aspect has also been realised by numerous British foundrymen—maybe, the one next door to you.

Foundry work, viewed from a modern aspect, is the cheap provision (by means of an automatic handling system) of chemically controlled metal of sufficiently high temperature and requisite fluidity, which is poured into either permanent or machine-made moulds. For the provision of cheap sand moulds, suitably prepared sand must be introduced into the box, either with sufficient pressure that no ramming is necessary, or the sand so introduced can be rapidly consolidated either by hydraulic or pneumatic pressure or by jog-ramming. The boxes must reach the machine or machines at least as quickly as they can be filled, rammed and stripped by the machinery available and obviously provision must be made for their equally rapid coreing up, closing and transportation for casting. A practical realisation of this system can be relied upon to halve, at a minimum, the capital outlay on boxes. The difficulties to be overcome are the provision of machines capable of economically dealing with a large range of patterns and "elastic" apparatus capable of dealing with varying sized boxes. America has more or less solved the problem for any one pattern, but British conditions, with a few exceptions, require greater elasticity than those obtaining across the Atlantic. At the moment it is difficult to hand such a scheme over to any one firm, but by a system of co-operation amongst the exhibitors a comprehensive arrangement could be chosen and assembled, including the balance of the machinery necessary for the knocking out and cleaning of the castings and their transference to the despatch department.

The demand for the Exhibition catalogue has been of the order of 1,000 copies for the Continent of Europe, and we suggest to the Dominions and Colonies that they would do well to emulate this example.

There are a number of sections of the foundry industry which make castings for which there is a great potential demand—domestic, municipal, agricultural, and certain engineering castings. May we ask them carefully to consider the following proposition:—Instead of waiting for orders to be received before commencing manufacture, estimate the cost of making 1,000 or 200,000 over a year of a given article on this best quantity-production lines. The work being practically automatic, it remains to concentrate on selling the product. Then come to the Exhibition with these thoughts uppermost in the mind and study the machinery shown to ensure that no other founder will be in a position to produce more cheaply. Then buy, and go ahead.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

The Cupola Furnace.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Mr. Cooper repeats, in a further letter, that the cupola pressure-gauge is useless for assisting in cupola control, and now tries to reduce the matter to ridicule by saying that all it tells us is that the fan is still running, and then goes on to say "that without a Pitot tube it tells us nothing about the oxygen supply."

Now the pressure of blast taken in conjunction with the power absorbed tells him as much about the oxygen supply as the Pitot tube does, it may not be quite as convenient as a direct reading from a volume pressure gauge, but my statement was that Mr. Cooper was not correct in saying that the pressure gauge was useless.

I further said that the volume pressure gauge, meaning the one operating with a Pitot tube, was not suitable for attachment to a cupola for daily use, but valuable for periodic tests, the reason being that its accuracy would soon be destroyed in the average case with the dirt associated with the air.

One would gather from Mr. Cooper's experience that reasonable cupola control is impossible, as he states that it has most to do with the way the man charges it and the weather conditions. Now while a man may be trained to do the charging job reasonably well, the weather will continue to defy us.

My reply to this is that while these affect the practical limits to which it is possible to control, the main consideration for controlling volume and pressure of blast is the height of the total charge in the cupola, and the internal diameter of the lining, and granted that the effective area of the tuyeres are not choked with slag, an increase in the quantity of blast will raise the pressure, or inversely a reduction will reduce the pressure.

That it is possible to control cupola plants is proved by a great number of up-to-date plants supplied by British makers which are easy to control, and which are giving good results day by day in spite of the weather.

Further, with regard to Mr. Cooper's remarks about the varying atmospheric conditions, I would call his attention to the fact that less power is absorbed in handling light or expanded air, and the pressure of blast will also be less, unless the speed of the blower is increased, and blowers working at high altitudes have to be increased in size to allow for the rarefied air conditions.

Mr. Cooper says an ammeter and voltmeter would cost more than a volume pressure gauge which I very much question, but as the voltage is generally known, an ammeter was what my letter suggested, and the cost of this is only a fraction of the gauge in question.

I am pleased to note in this week's FOUNDRY TRADE JOURNAL a letter by Mr. Wilson, of Stanton Ironworks, who from his experience supports part of my contention, and I agree that a volume-pressure gauge, whose operation is not interfered with by a certain amount of dust carried in the air, is a very valuable appliance for cupola control, and the matter becomes a question of the initial cost.

I do not feel called upon to give Mr. Cooper the information which he says in one paragraph would be very useful, and in another would be useless as the pressure indicated nothing, and he will no doubt find all the information he wants from "That full treatment by Spretson of 1876, and that period 20 years earlier," which he quotes.

Finally, I would like to add that it is not often necessary to make calculations from a formula giving volume from terms of blast pressure and horse power, as this is done inside the cupola, and the answer is given at the tapping spout, and granted that the man in charge has before him the pressure and power reading in amps. he soon has in his mind the combination which gives the best answer. Yours, etc.,

E. A. ROPER.

North Street, Keighley, June 1.

[This correspondence must now close.—EDITOR.]

American Cast Pipe Makers Merge Interests.

According to the "Iron Age," negotiations for a merger of several of the smaller producers of cast-iron bell and spigot pipe are reported, Dillon, Read & Company, New York, bankers, having been approached to arrange the details. Included are the National Cast Iron Pipe Company, Birmingham, and the Lynchburg Foundry Company and Glamorgan Pipe & Foundry Company, both of Lynchburg, Va. Efforts to include one Northern foundry in the merger are said to have been made.

Should the combination be confined to the three Southern foundries, the resulting corporation would rank among the large producers of cast-iron pipe, but would still only control a small part of the total production. It is estimated that their combined production would be something less than 200,000 tons a year, which compares with more than 600,000 tons, the estimated capacity of the leading producer, the United States Cast Iron Pipe & Foundry Company. The total production of all makers in 1925 was estimated at more than 1,350,000 tons.

It is noteworthy that, should such a merger be consummated, either of the two outstanding patents on the manufacture of centrifugal pipe would probably be available to the new corporation. The National Cast Iron Pipe Company has manufactured De Lavaud centrifugal pipe for some time, operating under license from the Centrifugal Cast Iron Pipe Corporation. The Lynchburg and Glamorgan companies are understood to be among the participants in patent rights on the "sand spun" process of centrifugal pipe manufacture, plants for the production of which are being built by the American Cast Iron Pipe Company, Birmingham, and R. D. Wood & Company, Philadelphia.

Gases in Metals.

A satisfactory method for determining the amount of oxygen and hydrogen in metals, which is generally applicable, has been developed by the United States Bureau of Standards. The method employs the principle of fusion of the metal in a vacuum, and the absorption of the resulting gases by suitable solid absorbents in tubes placed between the crucible and vacuum pump. A complete description of the method is given in Scientific Paper No. 514, of the bureau.

Nearly all metals contain small amounts of oxygen, hydrogen, and nitrogen, and these are frequently spoken of as "gases in metals," whether or not they exist as oxides, hydrides and nitrides, or in some other form. Many differences in quality of metals not readily attributed to differences in composition, as determined by the usual chemical analyses or to different physical treatments, are supposed to be caused by the presence of "gases" in the metals.

In the past, satisfactory and generally applicable methods for determining oxygen in metals have not been available. After many experiments, the vacuum fusion method, in which a small solid sample of the metal is fused in a gas-free graphite crucible, was developed. The water vapour, carbon dioxide, carbon monoxide and hydrogen evolved during the heating and fusion of the sample are absorbed as above described. The total oxygen and hydrogen in the sample can then be calculated. The method does not distinguish between oxygen present in the metal as carbon monoxide, carbon dioxide, oxides of non-metallic inclusions or of metallic constituents. Under the conditions of this analysis the recovery of oxygen from the oxides of iron, manganese, silicon, aluminium, titanium and zirconium is complete. The presence of sulphur in the iron or steel sample does not interfere with the determination of oxygen by this method.

The method is applicable to the accurate determination of oxygen in pure iron, steels, cast irons and pig-irons, and also in many non-ferrous metals and alloys.—"Iron Age."

Refractories in the Foundry.*

By H. V. Grundy and A. Phillips.

The thought which has prompted the authors to give this Paper is that a knowledge of the various refractory substances is of extreme importance to foundrymen generally and geologists do little to assist them. The amount of published matter upon this subject is very limited; it is found, therefore, that materials of vital consequence in the production of castings are being dealt with, and treated with a fair measure of success, from a wholly practical standpoint. Metallurgists have not acquired the same theoretical knowledge of the silicates, etc., which go to form these refractories, as they have of the chemistry of iron and steel, and consequently it has devolved upon the moulder to determine for himself what is required. During the past few years efforts have been made to fill this void, and we have had the investigations into the British Resources of Refractory Sands, conducted by Professor Boswell, of Liverpool University, of refractory materials, including fireclays, by F. R. Ennos, Dr. Alex. Scott, A. B. Searle, J. W. Mellor, and the British Cast Iron Research Association.

At present there is no complete set of standard tests or specifications upon which users of foundry refractories can rely for the selection of the best materials necessary for their various purposes, and the only way upon which foundries have to depend is by actual service tests, a method which is both time-consuming and expensive. The extent to which these materials enter into our every-day work is lost sight of by many, probably owing to the fact that we are fortunate enough to have good sources of supply, and it has undoubtedly been this abundance which has retarded investigation into this subject. Unlike some countries, England possesses important deposits of refractory materials, but little has been done until late years to ascertain their true extent, yet not only ironfounding but glass and pottery manufacture need its assistance, and its uses are so varied that even domestic use is found for it in polishing materials. It is not the object of this Paper to go too deeply into this matter from a geological standpoint, although it is a subject of great interest, but rather from the point of view of the foundryman who has sufficient interest in his work to have a desire to know something more of the materials which form the basis of his work, and to give some idea of the approach to a study of this nature.

To what extent does sand concern the foundryman? Probably very few realise the amount used in the production of a ton of castings. The figures shown will demonstrate the extent of the indefinite conditions existing in many foundries to-day, and as the writers are of the opinion that foundry losses are proportional to this, they can safely assume that if constant conditions could be maintained in the materials used such losses would be reduced to those governed by human error. Unfortunately to do this in its entirety is not at the moment a commercial proposition, but it has to be admitted that the value of exchanging amongst foundries data relative to sands obtained locally is not fully appreciated, and many beneficial results would be obtained if we sought for a closer knowledge of the sands used locally, and of those existing in our midst.

Sands.

Chemical and physical properties of moulding sands have been determined and given specific names, thus:—(*a*) Chemical analysis and mineral analysis, (*b*) fineness, (*c*) strength, (*d*) permeability, and (*e*) durability.

Obviously the first and probably the most important consideration is that the sand should be capable of withstanding the effect of great heat, and this property is dependent upon the amount of silica and alumina present and the comparative absence of alkalies and alkaline earths, such as potash, sodium, etc. (Table I). These latter combine with the silica and form silicates, and result in fluxing. This is a great disadvantage, and detracts very considerably from the appearance of the castings; thus it is seen that the actual value of an analysis lies in the readiness with which the figures given for silica, alumina, alkalies, lime magnesia, and iron oxides are appreciated. These are the contents to be sought for, and their influence correctly interpreted. Of course there are many other compounds present which have varying influences upon the sand, but broadly speaking they are relatively small in quantity, more or less difficult to determine, and may consequently be ignored. Further explanation of these constituents and their influence upon the whole will be given under the several headings, the next of which is fineness of grain size.

TABLE I.—*Sands.*

Analysis.	SiO_2	Fe_2O_3	Al_2O_3	CaO.	MgO.	Loss on ignition.	Alkalies.
Mansfield	83.5	2.74	8.31	1.5	0.47	1.95	1.53
Road	81.7	3.00	10.20	1.2	0.39	3.10	0.41
Manchester	85.15	2.61	7.77	0.66	0.63	1.90	1.28
Sea sand	90.70	2.61	2.53	1.56	0.71	1.35	0.54

Sieve Tests.	30—20	60—30	90—60	120—90	150—120
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Mansfield	3	10	25	52	10
Road	34	30	15	6	15
Manchester	0.5	29.5	47	7.0	6
Sea sand	5	60	27	5	3

Refractory Tests.			
Mansfield	Seger Cone No. 28	1630 deg. C.	2966 deg. F.
Road	,, ,, 20	1530 deg. C.	2786 deg. F.
Manchester	,, ,, 33	1730 deg. C.	3146 deg. F.
Sea sand	,, ,, 30	1670 deg. C.	3038 deg. F.

	SiO_2	Fe_2O_3.	Al_2O_3	CaO.	MgO.	Loss on Ignition.	Alkalies.
Erith	94.1	0.54	3.41	0.20	Trace	0.9	1.06
Belfast (Fine)	76.0	1.90	8.50	4.60	1.30	3.40	3.99
Belfast (Average)	82.3	1.8	3.30	1.0	0.9	1.60	3.30

Fineness of Grain Size.

This goes to distinguish between open and close sands, and calls for little explanation. This is clearly illustrated in Figs. 1 to 5. It should, however, be particularly noted that grains approaching the pebbly condition, and those approaching silt or dust should be avoided. For general purposes a sand should be reasonably coarse, the object being to obtain a material which possesses a maximum natural porosity and

* A Paper read before the Lancashire Branch of the Institute of British Foundrymen, Mr. F. G. Smith presiding. The authors are connected with the Metropolitan Vickers concern of Trafford Park.

FIGS. 1 TO 5.—ILLUSTRATING THE GRAIN SIZE IN MOULDING SANDS.

Fig. 1 (top) is sea-sand; Fig. 2, Mansfield; Fig. 3, coarse red sand; Fig. 4, fine red sand; and Fig. 5 (bottom), road sand. All are by 30 dias.

permeability, with sufficient bond to enable it to be moulded into the desired shape. Pore space should be evenly distributed, and for this reason wide differences in grain-size should be avoided, and round rather than angular grains will do much to assist porosity. Of course there are many uses for sand of small grain size, as in the light casting trade and the brass foundry, but where this is used it is desirable to assist venting by means of coal dust, etc.

Green Bond.

The next consideration is strength or bond, and this is of paramount importance. This property is due to the amount of clay (Al_2O_3, or expressed more precisely Al_2O_3, $2SiO_2$, $3H_2O$, *i.e.*, silicate of alumina) and ferric oxide present, and the ideal condition of their presence is in the form of thin films surrounding each grain, and in this condition it is at its maximum efficiency, as it retains in contact a certain amount of water. From data obtained it appears that all successful bonds depend upon what are known as colloids for this peculiar property. A "colloid" is a substance in a condition similar to that of gelatine or albumen, whilst in contrast a crystalloid is a substance like salt, for example. The main difference between the two is the varying amounts of surface energy, and whilst a solution of a crystalloid, such as common salt, will readily pass through a filter paper, the paper is practically impermeable to a colloidal substance like those mentioned. Clay possesses colloidal matter to varying extents, and in varying form, such, for instance, as hydrated ferric-oxide, aluminium silicate, and hydroxide, etc., and these substances possessing as they do structures more or less resembling a sponge, are able to retain considerable quantities of water. This water is peculiar in that, unlike hygrosscopic water, it is not all driven off at 110 deg. C., and consequently the life of the sand is proportionately lengthened. If a handful of sand is compressed and broken it indicates a green bond, which for general purposes is sufficiently reliable, but occasional tests of a quantitive nature can be usefully carried out from time to time.

Test for Cohesiveness.

For this test each sample of sand is dried at 110 deg. C., and the percentage of water added just before making the test piece. Test pieces are moulded in No. 1 box (Fig. 6). Sand is filled in loosely up to the top face, the top portion is then fitted on and the box is compressed until the joints meet, this enables each core to be made under similar conditions. The cores for the permeability tests are made in a similar manner with the exception that No. 2 box (Fig. 6) is used.

In testing for green bond the core, $\frac{3}{4}$ in × 1 in. × 8 in. long, is pushed by a ram over the edge of a horizontal glass surface until fracture occurs. Measurement is then taken of the unbroken piece.

In Table 2A is seen the green bond strength of a few of the sands commonly used in the Lancashire district.

It was thought that having the green bond strength of a number of sands a mixture could be calculated with a desired strength. Table 2B gives the various mixtures of these sands:—

Mixture No. 6 has an actual bond of 4.0 in. calculated bond of 4.2 in.

Mixture No. 7 has an actual bond of 4.0 in. calculated bond of 4.2 in.

Mixture No. 8 has an actual bond of 4.6 in. calculated bond of 4.16 in.

This assumption is not fully borne out when Mixture No. 8 is considered. It appears that the smaller grains pack in between the larger ones and affect the calculation of a bond strength.

Permeability.

Permeability is the facility with which a body allows the free passage of air or gas. As pre-

viously pointed out one of the greatest considerations in obtaining this is pore-space, evenly arranged. Rounded sand grains are a further consideration, but the one for which the moulder is responsible is the manner in which his ramming is performed, and the condition of the sand when this ramming takes place, and also the amount of water which some moulders swab with. One sometimes meets a moulder who makes constant use of a swab pot, and most moulders use it to some extent. It was the recurrence of trouble which caused the writers to seek the source of scrap in this direction, and in this criticism coremakers and moulders are included. However, the writers fitted up an arrangement of more or less simplicity, and made cores of standard design and size, but in the making of these cores varying quantities of water were used. The permeability figures obtained as a result of these experiments were most interesting, and went to show that too much care could not be given to the proper and equal tempering of sand, and that the moulder must exercise every possible care in ascertaining that he does not add too great a quantity of water either as a result of his facing sand drying or by swab pot methods. One is too apt to say that as it is a dry sand mould it does not matter to what extent water is added. It matters very largely, particularly previous to ramming or finishing, as wet sand rams much more closely than a dryer sand.

Table III shows the necessity for keeping a close control on the initial moisture content. A comparison of No. 2 Core with No. 5 Core demonstrates the effects of different degrees of ramming, especially when the sand contains a large percentage of water. When the durability test is described, an attempt will be made to explain when it is necessary to have a large percentage of water to obtain a medium bond.

Addition of Water to the Face of a Core.—Here is an attempt to produce similar conditions to a dried sand mould. The sand used in these tests was taken from the coremaker's bench. It demonstrates when comparing Nos. 1 and 3 against Nos. 2 and 4 that the amount of water sprayed on the face of a core or mould should be kept to a minimum although the mould is going to be dried.

In the permeability test-results shown the permeability is measured by noting the time taken to force 100 c.c.s. of air through a dried core 2½ in. dia. by 1½ in. deep. (See Fig. 7.) The volume of air is not corrected for temperature or pressure. A "blank" time is taken for each set of cores in order to obtain similar pressure for different cores.

At this stage two cores were tested for permeability by the use of a red liquid in the graduated tube, the members being able to see this when the 100 c.c. mark was reached. By placing a rubber stopper in the outlet orifice a

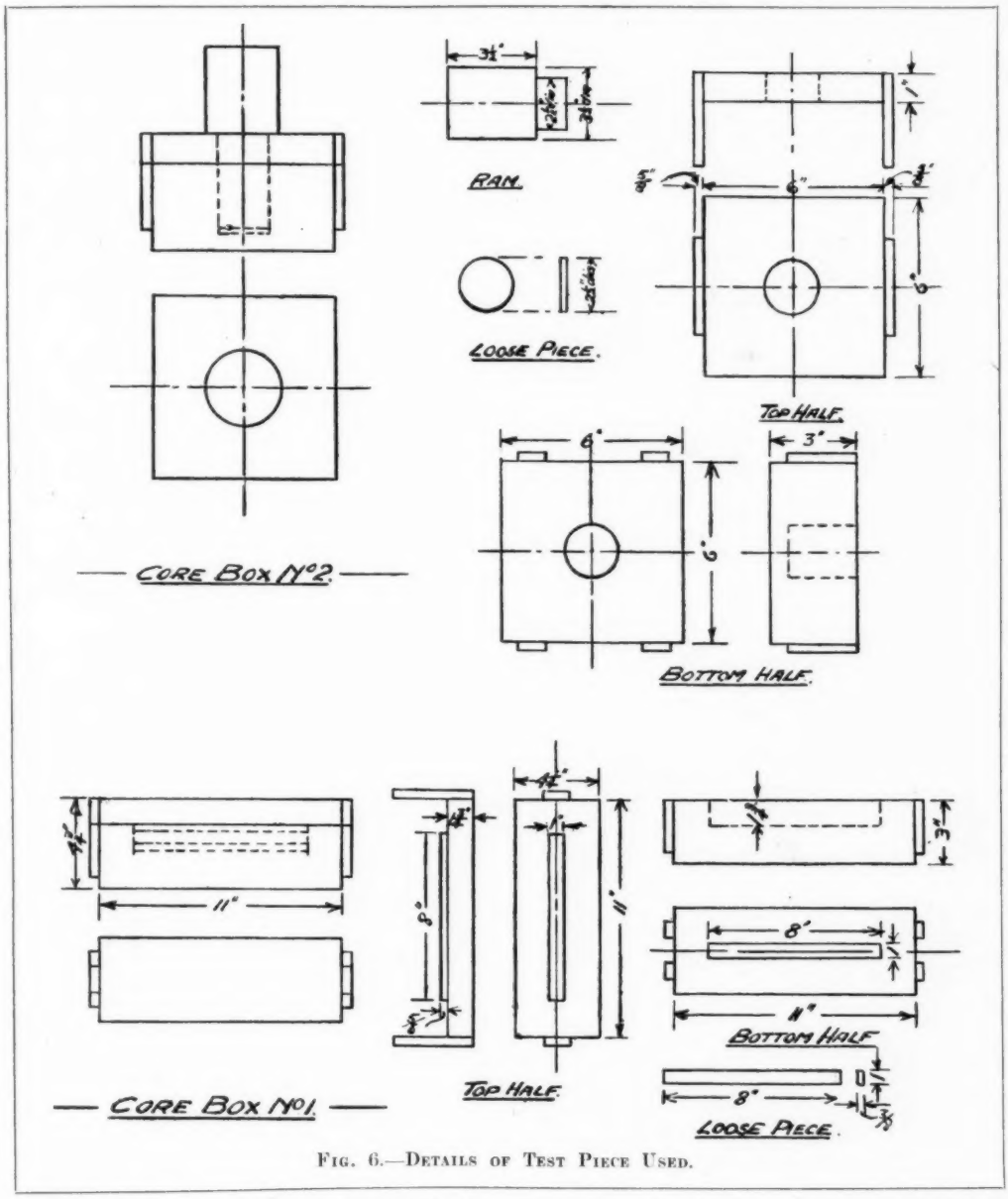


FIG. 6.—DETAILS OF TEST PIECE USED.

test was taken to see if there was any leakage. A soft rammed core took 29 secs. for 100 c.c.s. of air to pass through, similarly a harder core under similar conditions took 65 secs. for the same test.

Durability.

An equally important phase is that of durability, by which is meant the ability with which sand can be used and re-used, and a sand which has a low degree of durability may not be profitably used even though the analysis, fineness, permeability, and cohesiveness tests may indicate its suitability. Sands possess colloidal matter, and it is this which determines to a very great extent the durability of the sand. The problem is distinct from the problem of refractoriness or the resistance to fluxing, as it is conceivable that every refractory sand might have a very short life. The behaviour of much colloidal matter is distinguished by its dependence upon water, the content of which varies both with temperature and the neighbouring vapour pressure. Upon subjection to sufficient heat these colloids are destroyed. Their ability to take up water and again become possessed of a bond is lost, and the sand becomes dead. If it is not subject to too high a heat it will rehydrate and can be used for further work. The life of a bond is controlled by this critical temperature. Many clay bonds will stand a high temperature without breaking down, but are unfortunately subject to sintering, and in this condition they lose the colloidal property of again taking up water and consequently will not again take up bond. A combination of hydrated colloidal iron oxide and clay will give a long-lived bond and one that will readily rehydrate.

From heating curves taken on various sands the authors found a flat on the curve at 110 deg. C. and another flat between 480 deg. C. and 580 deg. C., on the majority of them, which points out that practically all the water in the clay is driven off between these temperatures.

Referring to Table IV, three sands were chosen for this test, fine, coarse, and open grades. They were heated uniformly with thermo-couples embedded in the sand. Green-bond tests were carried out as previously described. A cursory examination of the results shows the fact that road sand decreases in strength very rapidly, the loss in bond strength being 15.3 per cent. at 400 deg. C.

If it is assumed that the life or durability of a moulding sand depends entirely on the amount of bonding material it can retain after being subjected to high temperatures, it would be reasonable to tabulate the three sands as follows:—

Mansfield No. 1.—Having the longest life with only 2.5 per cent. loss in bond strength at 400 deg. C.

Manchester Coarse No. 2.—With a loss in bond strength of 5 per cent.

Road Sand No. 3.—With a loss in bond strength of 15.3 per cent.

This order of merit was borne out in tests carried out for dehydration and rehydration. Sands were heated to the desired temperatures and weighed. Afterwards they were entirely covered by water and allowed to soak for 24 hours. At the end of this period the samples were heated to 110 deg. C. to constant weight and the increase in weight taken as the water of rehydration.

The writers are fully aware that the dye-absorption test is frequently used for the measurement of colloidal materials, but a test to be of any use to the foundryman must show the quality of the bond. The dye-absorption test is very misleading when adopted for testing materials like fine silica flour, etc., as a test figure can be obtained although the material has little strength or rehydration value.

From the heating test figures it appears that the proper blending of a sea sand and a bonding sand is a suitable mixture for investigation to obtain a suitable long life sand, and it would be of great interest to foundrymen to find the longest life sand or mixture of sands that can be obtained locally without having to pay heavy rail charges.

Before leaving this subject it might be of interest to emphasise that two of the sands subjected to a temperature of 700 deg. C. required more water to obtain a medium bond strength. From this point, heap sand containing a large amount of burnt sand that will not rehydrate is not suitable for use in sand mixtures as excess water is necessary to obtain a working bond.

Blackings.

Blackings are substances used to protect the face of the mould from unnecessary burning and also to ensure that the casting will leave the mould without the adherence of fused sand. Thus

New Sands. TABLE IIA.—*Strength and Permeability of Sands.*

Sand.	Average Permeability.	Length after fracture.	Bond. Per cent.	Ratio of water to sand.
Mansfield	36.75 sec.	3.83 ins.	52.55	
Manchester (fine)	34.91 ,,	3.33 ,,	58.25	
,, (coarse)	28.90 ,,	5.20 ,,	35.0	1 : 10
Road sand	28.37 ,,	4.50 ,,	—	

Sand Mixtures. TABLE IIB.

No. of mixture.	Actual permeability.	Calculated permeability.	Actual bond.	Calculated bond.	Ratio of water to sand.
No. 6	28.9 sec.	32.2 sec.	4.0 ins.	4.2 ins.	
No. 7	30.0 ,,	32.1 ,,	4.0 ,,	4.2 ,,	1 : 10
No. 8	29.1 ,,	31.6 ,,	4.6 ,,	4.16 ,,	

(The amount of water required to obtain a medium bond is governed by the origin and condition of the sand. The water necessary varies from approximately 4 per cent. to 12 per cent.)

TABLE III.—*Varying Ramming and Percentage of Water.*

Test No.	Percentage of water.	Ramming.	Time to pass 100 c.c. of air through a dried core.
No. 1	12.0 per cent.	Light rammed	47.5 sec.
No. 2	12.0 ,,	Normal ,,	53.0 ,,
No. 3	12.0 ,,	Heavy ,,	82.5 ,,
No. 4	16.0 ,,	Light ,,	79.0 ,,
No. 5	16.0 ,,	Normal ,,	263.0 ,,
No. 6	16.0 ,,	Heavy ,,	449.0 ,,

The Effects of the Addition of Water to the Face of a Core made from Core Sand Mixture.

Test No.	Condition of green core.	Time to pass 100 c.c. of air through a dried core.
No. 1	Light rammed	28.0 sec.
No. 2	Light rammed. Face of core moistened with water ..	35.5 ,,
No. 3	Normal rammed	32.0 ,,
No. 4	Normal rammed. Face of core moistened with water	—

there is an additional means of assisting and prolonging the durability of the sand. Blackings are of several varieties and each has its special advantages. They can be divided into the following groups:—(1) Carbonaceous material; (2) mineral materials; and (3) mixtures of No. 1 and No. 2.

In the first group are included graphite, coke, charcoal, etc. In the second group there are

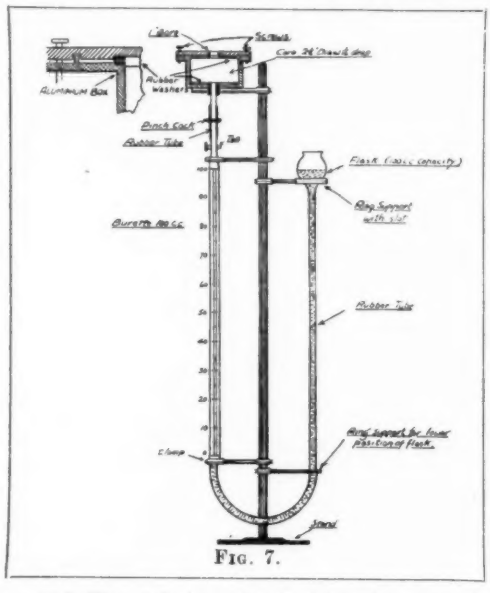


FIG. 7.

ground silica, talc (soapstone), china clay, cement, etc., and these are more correctly defined as mineral facings.

The blackings in the third group are most commonly used and consequently appear to be the best for investigation. Whichever of the materials is used there are varying methods used in their preparation and consequently it is found that in many instances what may appear to be insignificant details greatly affect the efficiency of the substance. During the past few years the writers have constantly sought for information upon this subject and are of the opinion that many good blackings are badly applied and consequently influences are not readily recognised by many, and a good deal of surprise was caused on the occasion when graphite cones were being subjected to heat tests. These cones were placed on small pieces of cast iron and after submitting them to a temperature it was found that they had actually caused a drop in the melting point of the metal in the immediate vicinity of the cone. Many surface defects upon castings can be directly attributed to blacking troubles.

Graphite.

This is the most important refractory material used for facing mould surfaces. Many varieties are offered for sale, the mineral running from the purest type, *i.e.*, flaky Ceylon quality, which is so pure that it is used for the best class of pencils, to the more common material so lacking in the greasy flaky characteristics of the purer material as to almost shade into a variety of coal. (See Table V.) The wide variation in samples from the same locality is very noticeable and it will be seen that some Ceylon plumbago contains 99 per cent. carbon. This is in a fine form that has a great covering power combined with a slow rate of burning. Other plumbagos are obtained from Cumberland, Bavaria, Canada and Mexico, with ash contents ranging from 2 per cent. in Mexican to 32 per cent. in Bavarian.

Plumbago burns slowly when heated to a high temperature with air, and leaves an ash containing most of its impurities, and as it has no apparent action on clay or sand it is used as a refractory separating layer between that and the molten metal.

Ground Coke.

Good hard coke with a low ash and sulphur content ground to extreme fineness in a ball mill and afterwards sieved, when mixed with plumbago and a suitable binder makes a satisfactory wet blacking for heavy dry-sand moulds.

Ground Gas Carbon.

Owing to the nature of its ash, etc., it is better than ground coke when mixed as a wet blacking. It is more costly, however, and from tests carried out it appears that ground coke or anthracite is more frequently used than gas carbon. Considerable skill is required in selecting, drying, grinding and mixing carbon for blacking manufacture. In selecting carbon, the class of coal used has to be considered as the percentage and composition of the ash are of primary importance. The temperature and period of drying the carbon before grinding require skilful judgment and is only attained after long experience.

Ground Charcoal.

This is also used in some of the mixtures, the best variety being that made from hard wood.

TABLE IV.—*Relation of Green Bond to Heat Treatment.*

Sand.	Heating temperature.	Length after fracture.	Green bond.	Percentage of added water.
Mansfield	110 deg. C.	3.9 ins.	51.2 per cent.	10.0 per cent.
,, ...	400 ,,	4.11 ,,	48.7 ,,	10.0 ,,
,, ...	700 ,,	5.64 ,,	29.5 ,,	10.0 ,,
Manchester—Coarse red ..	110 ,,	5.30 ,,	33.7 ,,	10.0 ,,
,, ,, ..	400 ,,	5.70 ,,	28.7 ,,	10.0 ,,
,, ,, ..	700 ,,	nil	nil	10.0 ,,
,, ,, ..	700 ,,	5.80 ,,	27.5 ,,	26.0 ,,
Road sand	110 ,,	4.45 ,,	40.6 ,,	10.0 ,,
,, ...	400 ,,	5.97 ,,	25.3 ,,	10.0 ,,
,, ...	700 ,,			10.0 ,,
,, ...	700 ,,	5.66 ,,	29.2 ,,	18.0 ,,

Mineral Facings.

Talc or soapstone is of the meta-silicic class $H_2Mg_3(SiO_3)_4$. Its high percentage of magnesia gives to it a soapy touch similar to graphite, but it can be readily distinguished from the latter by its whitish appearance. It is fusible at temperatures lower than graphite and water is expelled on heating. From this it will be seen that no difficulty is experienced when mixed with plumbago for thin castings, but it is totally unsuitable for use on heavy classes of work.

TABLE V.—*Plumbago.*

	Cumberland.		Bavaria.		Ceylon.		Canada.
Carbon	82	92	81	66	68	99	79
Volatile matter	5	1	8	1	5	—	2
Ash	13	7	11	32	27	1	19

(To be continued.)

Drilling Rawhide.—When drilling rawhide with a twist drill, difficulties are encountered in the shape of clogging up of the flutes of the drill. This difficulty is easily surmounted if ordinary toilet soap is held against the drill at regular intervals. Better results are obtained if the drill is run faster than in ordinary practice.

New Magnetic Separator for Feebly-Magnetic Minerals.*

BY H. S. HATFIELD, B.Sc., PH.D.

The chief drawbacks to the magnetic separation of feebly-magnetic minerals are, first, low capacity or high capital cost, and secondly, the difficulty of treating fine, wet material satisfactorily. The magnetic separator to be described is, it is hoped, an advance in these two respects, being based upon a principle which appears to be novel. The mineral powder to be separated is passed through a magnetic sieve consisting of several layers of iron wire, placed in a magnetic field the direction of which is at right angles to the layers of the sieve. The magnetic material adheres to the wires of the sieve, while the non-magnetic passes through. When the sieve is removed from the magnetic field the magnetic mineral falls off.

The figures show a wet separator with a single magnet. Fig. 1 represents a sectional elevation, and plan, while Fig 2 is a section along the line *p q* of Fig. 1. A is a horizontal disc of non-magnetic material which is slowly rotated about its vertical axis. The magnetic sieve B attached to the periphery of the disc A is formed of fine tinned-iron wires, stretched radially by being soldered to the brass rings, C C. These wires are of a thickness and spacing appropriate to the size of the particles to be treated, the thickness being of the same order of magnitude as the particles, and the spacing such as to allow several particles to pass abreast. The sieve passes between the poles of an electro-magnet N, S. In the drawing only one such magnet is shown, but as a rule several will be set at points equidistant around the sieve. D is a tank filled with water, the level of which is maintained by a supply sufficient to cause it to overflow through a waste pipe, not shown. Water also passes away continuously at H and at G (Fig. 2), carrying with it the magnetic and non-magnetic products respectively. The pulp or mixture of powdered ore and water, fed in at E, falls into the sieve, to be carried around by the same, the magnetic particles remaining in the sieve, the non-magnetic falling right through, the sieve not rotating faster than will permit of all non-magnetic particles having so fallen before the slot F is reached. Thus if the feed of pulp be set going with the current switched off, the speed of rotation of the sieve may be adjusted to the point at which mineral begins to pass beyond the slot F, and pass out at H. The flow of water through G also exerts a strong influence, since it causes a current which carries the mineral more rapidly through the sieve. We thus obtain the maximum speed of rotation, necessary for maximum output. When now the current is switched on, the adherent magnetic particles are carried on beyond F, and fall into D, and pass out at H. The direction of the field of the magnets, when there are several, is alternate, so that the sieve is completely demagnetised between each pair. The level of water in the tank is sufficient to keep the sieve totally immersed.

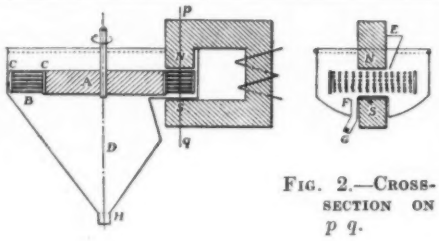


FIG. 2.—CROSS-SECTION ON *p q*.

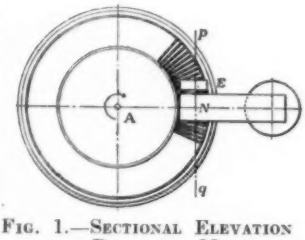


FIG. 1.—SECTIONAL ELEVATION AND PLAN OF MAGNETIC SEPARATOR.

For dry separation, of course, no tank is necessary, though if it be present, it forms no drawback, and precisely the same apparatus in every way may be used either wet or dry. When used dry, the armature may be rotated much faster, as the mineral takes much less time to fall through the sieve, and the capacity is therefore much greater.

Three of these separators have so far been built, two small machines for wet and dry separation, and a large machine with a 12-in. armature and eight field-magnets, built for Messrs United Water Softeners, Limited, of Brentford, for separating the mineral glauconite from the quartz sand with which it is associated in this country. This mineral, used in the well-known and highly successful "Permutit" process of water-softening by base-exchange, has hitherto been imported in large quantities from the United States, where it is found in a fairly pure state, requiring only to be washed free from clay. Here, however, it is found associated with an equal weight of quartz sand at least, and much clay. By means of the separator above described, the washed mixed sands are readily separated wet, dry separation being objectionable for certain reasons. The usual objection to dry separation, viz., dust, does not arise in this case.

This separator belongs to the class in which an iron armature furnished with sharp collecting edges is rotated to cut through the field of an electro-magnet. Now the capacity of such machines is largely determined by the size of the air gap in which the working field is produced, and the object of the designer is to make the utmost possible use of a given air gap. These machines work by the collection of magnetic particles upon sharp edges forming part of the armature, and the amount which can be collected depends upon the length of sharp edge which the designer can bring into his field space. Generally the armatures are of iron with sharp edges turned upon them in the form of grooves or ridges, whereas with the separator now being described, the armature is all edge, so to speak, and the length of edge which can be got into a given pole space is considerably greater than with other designs. Also, the wires are more effective as collectors than the same length of edge would be, since they can collect all round. This separator, therefore, has a capacity many times greater than any other of similar size.

It is difficult, of course, to state in any comparative form the efficiency of a magnetic separator, as the performance of any given machine varies enormously from one material to another, and still more according to the cleanliness of separation considered necessary. The cost of the large machine installed at Brentford is about £100, and it will treat about 3 cwts. of glauconitic sand of 30-60 mesh and containing 50 per cent. of glauconite, per hour.

Another interesting application of this separator is to the purification of coke. The ash-bearing particles of coal, when they contain iron, become magnetic on coking, and if the coke be finely ground they may be separated magnetically. At first sight the advantage of such a process may not be obvious. It is possible, however, to make excellent briquettes for burning in an open grate from gas-coke, provided the ash content be not too great. With too much ash present, the burning briquettes radiate little heat, owing to a coating of ash.

* From a Paper read, May 27, before the Institution of Mining and Metallurgy in London.

B.S. Tables of Brinell Hardness Numbers.—Standard tables of Brinell hardness numbers have been issued by the British Engineering Standards Association as Publication No. 240-1926. Recommendations are given in regard to the accuracy of the apparatus to be used for the test, the preparation of the test specimens, the magnitude and application of the load and the method of specifying the hardness. Copies of the new publication may be obtained from the B.E.S.A. Publications Department, 28, Victoria Street, London, S.W.1. Price 1s. 2d., post free.

The Moulding of Grooved Pulleys.

By Eugene Ronceray (Hon. Mem., Inst. Brit. Foundrymen).

(*Continued from page 368.*)

Moulding Without a Cope or a Core and Without Gumming.

This method (Fig. 6) is similar to the previous one, but does not necessitate gumming the mould nor securing the pattern. It is particularly suitable for a pulley of large dimensions. A kind of dummy box, as shown in the sketch (Fig. 6), is strickled. The lower part is pressed in the ground. A groove is made in which the dummy box is placed, and a mess of sand is rammed into it as previously described.

Precautions have been taken, of course, to align the dummy box. The top part is rammed up, observing the usual precautions. The half rim is

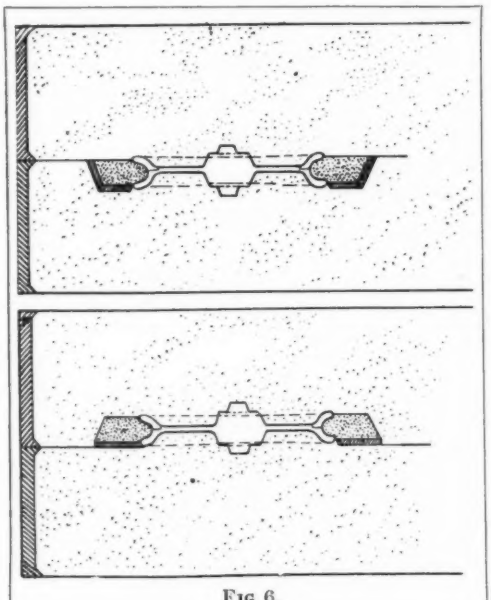


FIG 6.

then removed, and it is then possible to lift the dummy box with the rammed mass of sand.

This frees the main part of the pattern, which is removed, after which the dummy box can be put back into place and the mould closed after having put the central core into place.

Another similar method consists in replacing the dummy box by a simple plate or ring. The lower part is printed down, the plate put into place, the sand rammed up, a template being passed over it to give it a suitable shape, after which the top part is put on, clamped, and then removed. When this is done, the pattern is removed, the central core inserted, the top replaced, and the mould is finished.

Vertical Moulding Using Sectional Patterns.

The method of end moulding by means of a sectional pattern is shown in Fig. 7, and it may be carried out in various ways.

Fig. 7 shows a pattern having a web as a loose piece and a rim in two parts cut in a diametral plane. The rim and web are assembled by means of a circular jointing along V. Moulding is carried out in two parts of a box in a diametral plane passing through the joint of the rim. The core and web are stripped quite normally. The two halves of the rim remain in the sand, each in a portion of the box. The next thing is to remove them.

The arrangement selected is that adopted when manufacturing on a modest scale, and there is no need to make expensive equipment. To get the rim out, a small plate is made in which holes have been cut corresponding to its section.

This tool is really a small stripping plate having two holes opposite one of the imprints. The part of the rim visible is gripped by means of a small screw, and extracted by drawing through the stripping plate.

This method, which is not very well known, works perfectly. A considerable number of tramway trolley pulleys have been made in this way. The groove is turned and fitted to a turned web. It is not even necessary to use a complete stripping plate, but a small piece of tin plate, which is placed on the mould to enable the half-rims that are in the mould to be withdrawn separately.

Stripping by Rotation Through a Stripping Plate.

Another method is to mould the pulleys on edge by means of a half-pattern disappearing across a stripping plate. Fig. 8 shows how this is done. One is dealing here, of course, with pulleys cut through the middle, and which may be turned through 180 deg. for stripping.

The mould is first of all rammed up. The stripping plate used is more complicated than that described in the previous process, as the pattern has only to be given a half-turn to obtain a complete portion of a box.

This arrangement is only suitable for the quantity production of pulleys, because the equipment required is somewhat expensive. Reversibility has been obtained in a way which gives almost automatic precision.

A reference to Fig. 8 will show that the axis is used in this case for lining up. In the extension of each side there is a sort of hollow boss, on which is placed the corresponding recess in the box

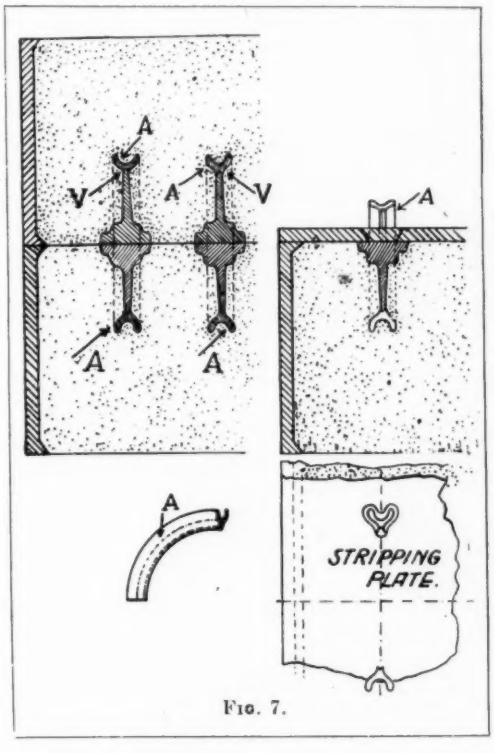


FIG. 7.

edge, which has no dowels, lining-up being effected simply by this housing.

A box is placed on top. This is simply a box about twice the width of the pulleys; and, when this box is being cast, two spools similar to those on the axis are placed in the mould. As a result, the housings are chill-cast, and, consequently, the proper diameter and thickness are maintained.

But when this box has been cast it will be very difficult to ensure that the two ends are strictly equidistant as the shrinkage is not the same. There may be differences in the casting temperature. It

is impossible to ensure such precision that the two walls of the box are at the same distance. But there is no need for this, provided that the thickness of one of the housings ensures absolute alignment lengthwise. It is sufficient to use a double-shoulder spool on a single side. The other housing, used with a spool not fitted with a shoulder, will ensure perfect diametral alignment on the opposite side.

If these conditions are observed, there is every certainty of returning correctly to the same place each time. Finally, as there is only one line of pulleys, the symmetry of the pattern is absolute, whereas it is difficult to obtain with two lines.

Double-Sided Pattern Plates.

Fig. 9 shows the method using double-faced pattern plates in pairs. This process is but little known, but enables a very large number of small grooved pulleys to be made by hand with considerable speed. Two double-sided pattern plates are first of all made. To do this, the patterns are taken and moulds made, the two parts of the mould are separated by means of thickness wedges, and the plates are then cast. The result is a plate having the same surface as the surface of the joint of the box, and at various parts the plate has the same thickness as the pattern.

Having taken as an example patterns of small pulleys, it will be necessary, after all, to cut the pattern through the middle, although this was previously said to be unnecessary. A half-pulley with its boss is accordingly taken, and a mould formed with the outside joint brought into the middle plane, as shown in the drawing.

This operation completed, the pattern plate "A" shown in Fig. 9 will be obtained. Two pattern plates should be made in this way, and they will form two of the plates enabling moulds to be obtained of the half-patterns that were taken as the starting point.

Referring to the drawing, the operations to be carried out are as follows:—First of all, the small cavities C, C^1 are filled with sand. These cavities have remained, and form half core boxes. After scraping, the two plates are moulded like the pages of a book. Consequently, the two half-cores of each pulley will form the masses of sand necessary to make the complete core for the groove. The next thing is to ram one half, say the top half. This is then lifted off, the plate removed, and the top part replaced.

The result is that the core is pressed between the top mould and the lower plate. When this is done the whole is turned over and the bottom half rammed, after which it is removed and the bottom plate also removed, then the bottom part of the box is replaced.

By following these operations a series of masses of sand has been rammed between the pattern plates, and these masses, when united, form complete cores. Further, a portion of the mould that was replaced has been forced on to one of these cores. Turning the box over, the same operation has been performed on the other side, and in this way a large number of small pulleys have been moulded very quickly.

Another method consists in moulding with loose pieces of core, and this is shown in Fig. 10. An ordinary pattern is made, which is not cut.

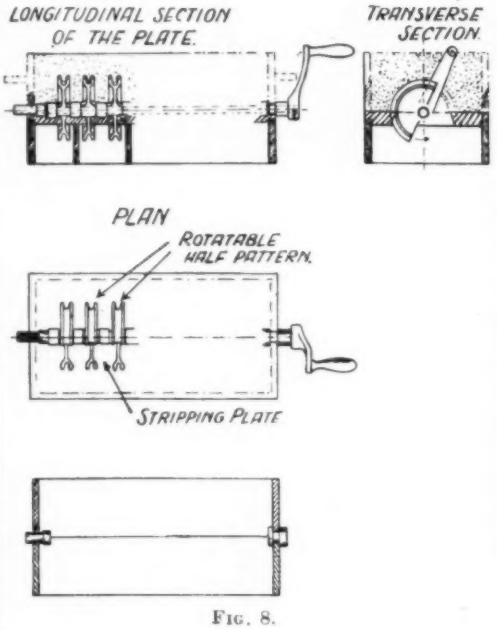


FIG. 8.

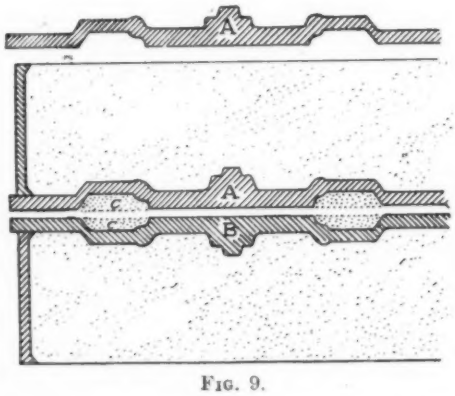
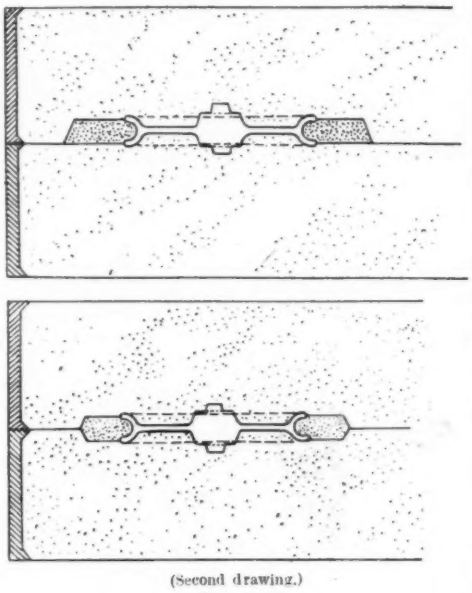


FIG. 9.



(Second drawing.)

FIG. 10.

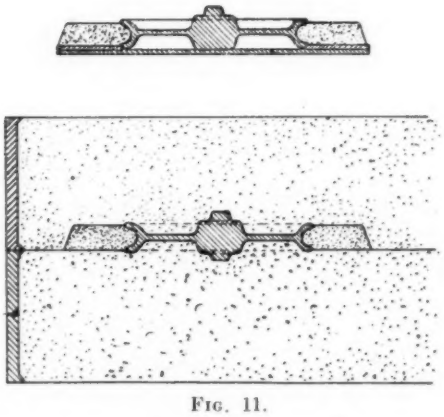


FIG. 11.

This is a classical and very simple method, and it calls for very little description. A summary of the operations is as follows:—The bottom is printed, the loose pieces are secured in the groove, the top is rammed, lifted, the loose pieces of core are withdrawn, the pattern withdrawn, the loose pieces re-inserted and assembled. Certain precautions are necessary, and these are shown in the first sketch. If the loose pieces had been made according to the second drawing, it would have been impossible to withdraw the parts. To withdraw them a much wider angle would have been necessary, enabling them to be withdrawn aslant. This is not practical.

In Fig. 11 is shown the method of moulding on to an old casting. Very often repairs are necessary to a casting. Supposing a piece of the casting is received from a customer in the country that is to be replaced quickly, and there is no time to make the necessary pattern, the following method may be adopted.

The casting is placed on a cast-iron plate, and a cast-iron crown is fitted outside so as to reach approximately to the joint of the lower rim. Then an oil-sand core is formed in the groove. The joint is suitably made, and the whole is taken to

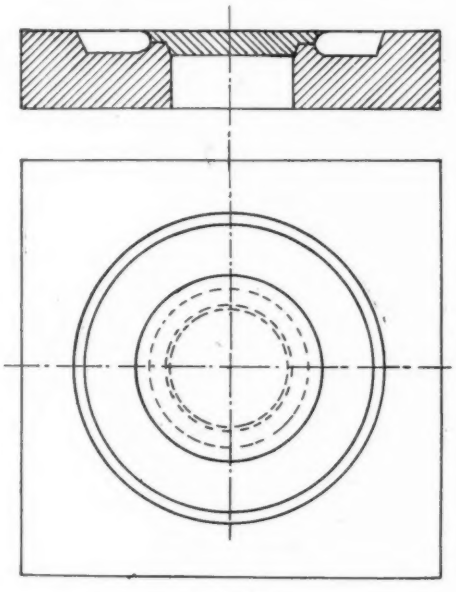


FIG. 12.

the stove. Before doing this the precaution should be taken of making three or four V cuts round the periphery. The whole has now the appearance of a part having a dried core in the groove. The cuts made are plugged up with sand, and a mould is made just as if one were working with a pattern having a top print. When the pattern has been taken out, a core having suitable cuts in it will be obtained, and, after the sections of the dried core have been broken off and removed from the old casting, they are placed in the mould. The empty spaces that occur should be plugged up, when a kind of core is obtained. To return to the starting point, where the question of the proper way to design the core box suggests itself. Certain workers provide for a partial box necessitating a number of cores for the complete groove. This procedure is not recommended; it is a long business, and yields cores that are not well supported and which would produce at every joint a burr which would fray the pulley-rope unless the burr were carefully removed. The classic core-box is that shown in the illustration, Fig. 12. The bottom gives the mould of the groove up to the dividing line. A detachable part completes the mould of the groove. The box is open and is of the same depth as the core. The sand is packed into it, and the part withdrawn. A plate is placed on the joint of the box, and the whole is turned over, and it only remains to withdraw the box. This is an exceedingly simple matter.

Patent Specifications Accepted.

The following list of patent specifications accepted have been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full specification can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

The last numbers in each case are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

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30,490. CANNON, H. B. Ovens or furnaces. (May 14, 1924.) 234,049.

5,485. WHITE, A. E. (American Arch Company). Furnace roof structures. February 27, 1925. 249,297.

6,707. KETIN, T. Machine or apparatus for treating or preparing moulding-sand. March 12, 1925. (Addition to 247,683.) 249,313.

9,466. THOMAS & COMPANY, LIMITED, R., and JONES, E. A. Cleaning or scouring machinery employed in the manufacture of tinplates. April 9, 1925. 249,332.

23,001. KOCHLIN, W. Sheet-metal piling. September 29, 1924. 249,573.

Laboratory for Testing Manufacturing Materials.—In compliance with the request of the Chinese Engineering Association at Shanghai, the China Education and Culture Fund Commission has sanctioned the appropriation of $110,000 for the establishment of a laboratory for testing engineering materials and an engineering library. The association is to co-operate with Nanyang University in the matter.

XUM

THE IRON AND STEEL INSTITUTE.

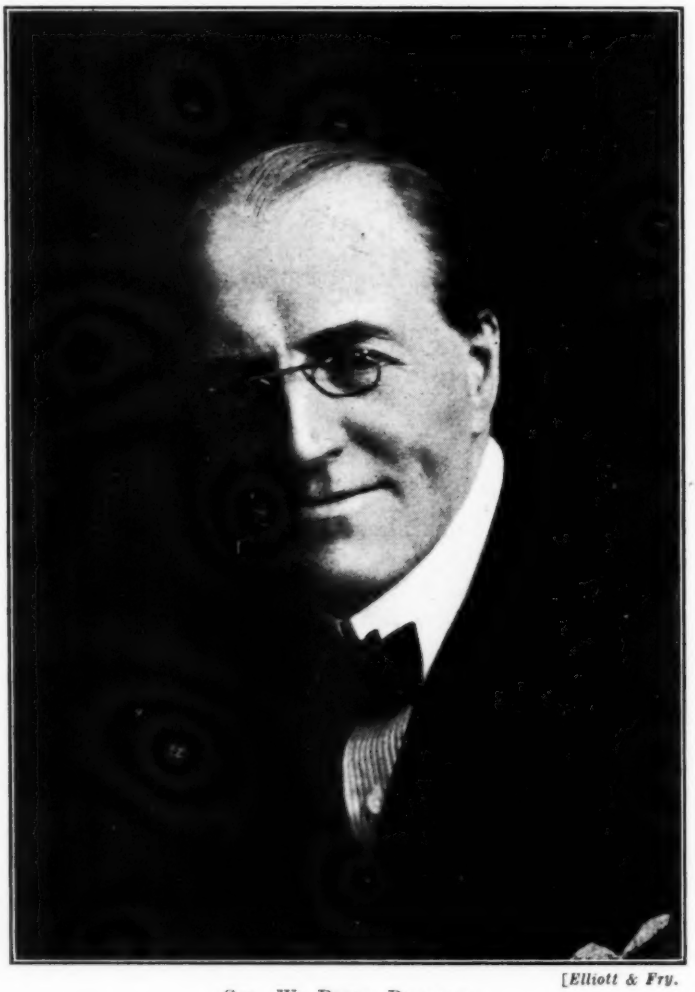
As briefly noted in last week's issue, the Annual Meeting of the Iron and Steel Institute, originally fixed for May 6 and 7, but unavoidably postponed owing to the national strike, was opened to-day and will be continued to-morrow at the Institution of Civil Engineers, Great George Street, Westminster, when the new President (Sir W. Peter Rylands) was inducted and delivered his presidential address. Sixteen Papers, some of which are of exceptional interest and importance, are down for reading.

Report of Council.

The Council of the Institute, in their report on the proceedings and work of the Institute during the year 1925, state that during the year 65 new members and 8 associates were elected, and 6 associates were transferred to membership. The total membership of the Institute on the register on December 31, 1925, was therefore as follows: Patron, 1; honorary members, 11; life members, 78; ordinary members, 1,899; associates, 33; total, 2,022. Fifty-nine members and two associates resigned their membership during the year, and the names of 37 members were removed from the register owing to the non-payment of their subscriptions.

The deaths of 36 members occurred during the year, and the Council place on record their sense of the great loss to the Institute, and to scientific metallurgy in general, incurred through the death of Dr. J. A. Brinell, the world-famous Swedish metallurgical engineer, and Bessemer Medallist of the Institute. They also deplore the loss of other distinguished members and faithful supporters in the persons of Baron Evence Coppée, Captain H. Riall Sankey, R.E., C.B., C.B.E., and Mr. Isaac E. Lester. The last named was a member of the Executive Committee of last year's Birmingham Meeting, and took an active part in organising the arrangements for the reception and guidance of the members.

Honours Conferred on Members.—The Council tender congratulations to several members of the Institute upon whom appointments of honour and distinction have been conferred during the year. The President of the French Republic conferred the Insignia of Officer of the Legion of Honour upon Sir Robert A. Hadfield, Bart. (Past-President). Sir William Ellis, G.B.E., D.Eng. (Past-President), was elected President of the Institution of Civil Engineers. Mr. G. E. Falck has been made Cavaliere Ufficiale of the Order of St. Maurice and St. Lazarus. Mr. C. P. Sandberg has been created a Commander of the Order of the White Elephant of Siam, while Mr. N. P. Sandberg and Mr. O. A. F. Sandberg have each received the Order of the Crown of Siam. Mr. Luis Barreiro has been appointed Consul of the Dominican Republic at Bilbao. Dr. R. Moldenke was to be congratulated upon being the first recipient of the Joseph S. Seaman Gold Medal of the American Foundrymen's Association. Mr. J. de Lazurtegui has been made an Honorary Member of the American Academy of Political and Social Science; Dr. D. H. Ingall has obtained the degree of D.Sc. at the University of Birmingham; and Dr. Constance F. Elam has been equally successful in Metallurgy at the University of London. The Honorary degree of Doctor of Commercial



[*Elliott & Fry.*

SIR W. PETER RYLANDS.
(President-Elect of the Iron and Steel Institute.)

Science has been conferred on Judge E. H. Gary by New York University.

Finance.—In presenting the annual statement of accounts for the year 1925, the Council express much regret in announcing that Mr. Illtyd Williams has found himself compelled to resign the Hon. Treasurership, which office he has held for the last ten years. During this period he has rendered invaluable service to the Institute, and his retirement is greatly regretted by all. The income of the year under review, exclusive of the Carnegie Scholarship Fund and of the interest received from the Special Purposes Fund, was £7,952, and the expenditure was £8,084, as against £8,068 and £7,568 respectively in 1924.

Andrew Carnegie Research Scholarships.—On the recommendation of the Carnegie Scholarship Committee, grants were made by the Council during the year to the following candidates:—

W. CRAFTS (Reading, U.S.A.), £100, to carry out a research on the production of carbonless chromium by the method of leaching and electrolytic deposition of chromium from chromite.

W. H. DEARDEN (London), £100, to study the specific heat of iron below 400 deg. C.

T. H. TURNER and E. W. FELL (Birmingham), £100 jointly, to investigate methods of detection and the nature of permanent deformation or strain in steels.

R. HIGGINS (Glasgow), £100, to study the volume changes in cast iron brought about by repeated heating and cooling.

H. O'NEILL (Manchester), £100, to study the nature of hardness in relation to cold-working and machining properties of metals.

J. H. PARTRIDGE (Birmingham), £50, to investigate the electric and magnetic properties of cast iron.

L. B. PFEIL (Swansea), £100, for a study of the growth of large crystals by annealing strained iron, including the properties of such crystals.

It was also recommended that, the Committee having satisfied itself as to the good progress of the research work undertaken by the four following investigators, to whom grants had previously been awarded, further grants be made to them of the amounts specified:—

C. H. ADAMSON and G. S. BELL (Sheffield and Lincoln), £50, to continue their research on transverse cast-iron test-bars.

D. W. BERLIN (Rasunda, Sweden), £50, to study the specific gravity of liquid iron.

A. L. CURTIS (Chatteris, Cambs.), £50, to assist his investigations on steel moulding sands.

E. R. TAYLOR (Birmingham), £50, to continue his study of the effect of manganese and sulphur on the properties of malleable cast iron.

Changes on the Council.—Professor J. O. Arnold has been elected an Honorary Vice-President, and Mr. Arthur Dorman was chosen to fill the vacant seat on the Council. In accordance with Byelaw 10, the names of the following Vice-Presidents and Members of Council were announced at the Autumn Meeting as being due to retire at the Annual Meeting, 1926:—*Vice-Presidents*—Lord Airedale; Mr. B. Talbot; Mr. W. R. Lysaght. *Members of Council*—Professor T. Turner; Mr. E. H. Saniter; Mr. John Craig; The Hon. R. D. Kitson, D.S.O.; and Professor H. C. H. Carpenter. In the absence of other nominations all are eligible for re-election.

New Members and Associates.

The following is a list of the names of those proposed for election as Members and Associates of the Institute at the meeting:—

Members.

Allison, F. H., Jnr., Sheffield (student); Baird, Du Bois, Steubenville, Ohio, U.S.A. (blast furnace superintendent); Beesly, G. S., Birmingham (steel manager); Brandt, B., Richmond, Surrey (engineer capt., late Russian Navy and Chief Engineer Inspector of Russian Admiralty in London); Brown, T. W., Wells Green, near Crewe (head of testing Department, L.M.S. Railway, Crewe); Caddick, W. A., Middlesbrough (secretary, Cargo Fleet Iron Company, Limited, etc.); Carlson, A., Forsbacka, Sweden (metallurgical engineer, chief chemist); Chance, K. M., Leamington (general manager, Silica Gel., Limited); Cleeves, F. R., London (iron and steel merchant); Cocito, *Ing.* M., Turin, Italy (steelworks manager); Cookson, H. E., West Bromwich (general manager roll foundry); Corlett, W. H., Queensferry (assistant superintendent engineer in steelworks; Cotterell, W. J., London (engineer); Deeley, R. B., Twickenham (metallurgist); Dockray, T., Buffalo, N.Y., U.S.A. (metallurgist and chief chemist); Duffield, F. L., Brassington, Derbyshire (managing director); Fetchenko - Tchopivski, I., Krakò-Podgòrze, Poland (prof. of metallurgy); Freeman, H. B., Chester (metallurgist); Gandarias, P., Bilbao, Spain (director of steel works); Gustafsson, E. G., Stockholm (metallurgical engineer); Hall, S. E., Vereeniging, Transvaal, South Africa (roll designer); Heath, O. W., Sheffield (chief metallurgical chemist); Hume-Rothery, W., Oxford (metallography research); Jackson, Capt. H. H., Chesterfield (blast furnace and iron works manager); Johansson, Prof. K. Ar., Djursholm, Sweden (metallurgical engineer, etc.); Jones, S. H., Ashford, Kent (works manager); Kriegsheim, H., New York, U.S.A. (mechanical engineer); Lemmy, R., London (metallurgical chemist); MacIntosh, J. R., Birmingham (civil engineer); Metcalf, N., Manchester (student); Milling, H. R., Warrington (engineer and chemist); Misángyi, *Dr.* W., Budapest, Hungary (professor on the University); Mukerji, M. N., Sheffield (student in metallurgy); Parsons, W. H., Wednesbury (engineer in iron and steel works); Peat, C., London (secretary, National Federation of Iron and Steel Manufacturers); Perrett, L. A. S., Briton Ferry, Glamorganshire (metallurgical chemist); Pfeil, L. B., Swansea (university lecturer); Prashad, M., Tundla, United Provinces, India (inspector of work); Raine, A. J., Stocksfield-on-Tyne (director and works manager); Raine, J. E., Newcastle-on-Tyne (managing director); Sen, P. K., Alipur, Calcutta, India (chemist); Senior, E. W., Sheffield (director); Steel, R., Doncaster (steel works manager); Talbot, B. C., Darlington (iron manufacturer); Taverner, G. B. R., Roehampton (managing director); Tonge, J., Vereeniging, Transvaal, South Africa (foundry manager); Tornblad, J. T., London (metallurgist and engineer); Watson, E. A., Coventry (electrical engineer and metallurgist); Wolff, *Lieut.-Col.*, Birmingham (managing director); Young, W. A., London (editor).

Associates.

Buckingham, F. A. T., Gillingham, Kent (founder); Cary, C., Hale, Cheshire (assistant works manager); Evans, R. W., Merthyr Tydfil (pupil); Pearson, T. F., Dudley, Worcestershire (student); Slater, I. G., Malvern, Worcestershire (research student); Woodward, C. S., Birkenhead (student).

Turkish Floating Exhibition.—The date of the departure of the ship carrying the exhibition referred to in our issue of April 30 has been put back a week. Consequently the dates on which the ship will visit Liverpool will be probably from June 23 to June 26, and London from July 2 to July 6.

Production of Single Crystals of Metals and Some of their Properties. — The 16th May lecture to the Institute of Metals was delivered recently by Prof. H. C. H. Carpenter, having for its subject the production of single crystals of metals in bars, sheets, etc. (including iron, tungsten, aluminium, etc.), and pointing out the difference in properties between a metal as ordinarily prepared consisting of small crystals and the same metal in the form of a single-crystal test piece. On the one hand, a round bar of the former when pulled maintains its circular cross section throughout, finally breaking with a cup and cone fracture; a square bar of the same metal breaks with a square fracture. On the other hand, in the form of a single-crystal test piece, a soft metal like aluminium pulls out along two conjugate planes forming an ellipse, and ultimately breaks with a very characteristic double-wedge fracture. The fracture is totally different if the aluminium is hardened by the introduction of, say, zinc.

XUM

A Quick Testing Method for Cast Iron.

There is a need for a quick method of testing the iron before pouring. The methods nowadays in use (examination of quality according to appearance of fracture of a test bar or according to the depth of chill in a larger test piece cast into a chill mould) waste too much time. The iron cannot be kept in the ladle till the test pieces have wholly cooled down. P. Wolff found [Stahl und Eisen, April 29, 1926, p. 560-4] that the quality of an iron can be best judged by examining the fracture of a wedge (depth of chill proceeding from the edge, merging of the chilled zone into the grey texture sharp or gradual, structure of the upper part of the wedge) of the shape according to Fig. 1, which cools down very quickly. Of course, the wedges must always be cast under the same conditions as far as moisture and permeability of the moulding sand and temperature of the iron, are concerned. The trustworthiness of the wedge test was checked by the Brinell and Shore hardness tests, because these tests are a better measure of the quality of cast iron than the tensile test. The experiments were made with the following qualities:—(*a*) Ordinary machinery iron; (*b*) special cast iron (i) with high strength; (*c*) special cast iron (ii) for high temperature; (*d*) special hard cast iron (iii). The average composition was:—

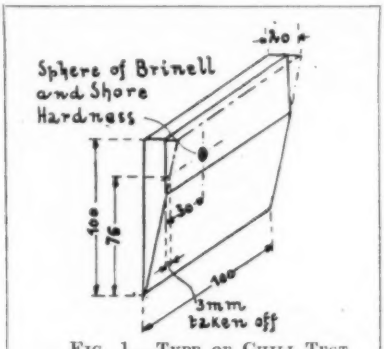


FIG. 1.—TYPE OF CHILL TEST PIECE USED.

	C.	Si.	Mn.	P.	S.
(*a*) ..	3.5	2.15	0.75	0.8	0.1
(*b*) I. ..	3.4	1.7	0.8	0.5	0.09
(*c*) II. ..	3.4	1.4	0.45	0.2	0.09
(*d*) III. ..	3.3	1.2	1.1	0.4	0.08

The test results were derived from the following principles:—

(1) For each quality of iron there were summarised those experiments in which the values of wedge test, Brinell and Shore hardness were in accordance with each other, that is if they decreased or increased equally with regard to the preceding values. The results are given in Table I. The machinery casting shows the worst values. This comes from the fact that a negative value of the wedge chill cannot occur; therefore all the values which are below the point where the chilling of the wedge ceases are not included.

TABLE I.

Quality.	Brinell Shore Wedge.	Brinell Shore.	Brinell Wedge.	Shore Wedge.	Brinell Shore Wedge Tests different.	Sum.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	
Machinery casting	28.6	30.0	15.3	11.8	14.3	100
Special cast iron I	30.0	22.7	16.8	15.5	15.0	100
" " II	38.2	20.6	15.7	10.9	14.6	100
" " III	47.0	14.7	11.8	14.7	11.8	100
Average value	35.9	22.0	14.9	13.3	13.9	100

TABLE II.

Brinell Hardness.	Machinery Iron.			A Special Cast Iron I.			B Special Cast Iron I.			Special Cast Iron II.			A Special Cast Iron III.			B Special Cast Iron III.		
	Number of Brinell Hardness Tests.	Depth of Wedge Chill.	Shore Hardness.	Number of Brinell Hardness Tests.	Depth of Wedge Chill.	Shore Hardness.	Number of Brinell Hardness Tests.	Depth of Wedge Chill.	Shore Hardness.	Number of Brinell Hardness Tests.	Depth of Wedge Chill.	Shore Hardness.	Number of Brinell Hardness Tests.	Depth of Wedge Chill.	Shore Hardness.	Number of Brinell Hardness Tests.	Depth of Wedge Chill.	Shore Hardness.
179	24	1.25	34.25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
187	126	0.43	33.00	—	—	—	—	—	—	6	3.0	34.0	—	—	—	—	—	—
192	6	0.00	34.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
197	350	0.36	35.40	24	3.5	34.5	12	9.5	35.0	30	6.8	34.2	—	—	—	—	—	—
201	60	0.90	35.90	12	4.0	34.0	12	9.0	35.0	18	6.3	36.0	6	15.0	39.0	—	—	—
207	408	0.90	36.00	144	3.9	35.6	66	3.9	34.5	144	5.92	34.6	—	—	—	6	18.0	36.0
212	108	0.90	35.35	72	3.7	35.8	6	5.0	37.0	24	7.5	36.8	18	7.0	37.0	—	—	—
217	414	1.30	35.50	258	4.6	36.0	120	6.1	35.9	216	6.28	35.4	36	16.1	36.8	12	11.0	37.0
223	48	2.50	35.30	36	4.7	36.0	18	8.0	37.0	42	8.45	36.1	—	—	—	—	—	—
229	144	2.90	36.30	270	5.9	36.5	120	6.7	37.1	156	7.8	36.5	84	13.8	37.1	54	20.6	37.5
235	6	6.00	39.00	44	6.57	37.5	24	4.0	38.0	24	8.75	37.0	18	17.6	36.0	24	23.2	36.0
241	6	5.00	—	156	7.28	38.0	30	7.6	37.1	60	10.20	38.8	84	18.6	37.8	54	23.0	38.0
248	—	—	—	6	9.00	37.0	6	11.0	38.0	—	—	—	24	19.2	37.8	—	—	—
255	—	—	—	30	7.20	39.2	6	17.0	40.0	12	12.5	41.0	36	21.5	39.8	30	24.4	38.8
262	—	—	—	—	—	—	—	—	—	—	—	—	6	14.0	38.0	—	—	—
269	—	—	—	24	12.2	34.5	—	—	—	—	—	—	—	—	—	12	34.0	41.0
285	—	—	—	—	—	—	—	—	—	—	—	—	6	25.0	55.0	—	—	—
302	—	—	—	12	6.5	56.5	—	—	—	—	—	—	—	—	—	6	90.0	42.0
352	—	—	—	6	10.0	55.0	—	—	—	—	—	—	—	—	—	—	—	—
415	—	—	—	6	7.0	55.0	—	—	—	—	—	—	—	—	—	—	—	—
429	—	—	—	—	—	—	—	—	—	—	—	—	6	10.0	—	—	—	—
444	—	—	—	136	10.0	68.0	—	—	—	—	—	—	—	—	—	—	—	—
	1,650	—	—	1,146	—	—	420	—	—	732	—	—	324	—	—	198	—	—

while the hardness test does evaluate the soft texture of the machinery iron. The special cast irons 2 and 3 show the best results; this proves the importance of a known furnace charge using special pig-iron and omitting any iron of unknown origin.

The test values were plotted on the supposition that the Brinell hardness is the best measure of quality; the average values of the hardening depth

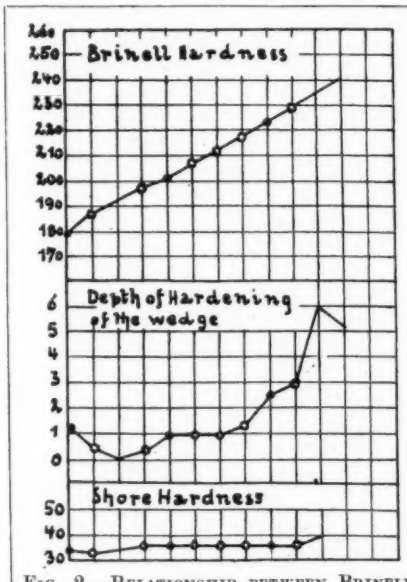


FIG. 2.—RELATIONSHIP BETWEEN BRINELL, CHILL AND SHORE HARDNESS TESTS.

and Shore hardness were plotted vertically below the corresponding Brinell values. The test values are shown in Table II. Fig. 2 is the diagram for machinery iron; the circles are the average values of at least 60 samples, the points those of 30 samples. By means of the formula of Schuetz [$kz = \frac{H - 40}{6}$; H = Brinell hardness] it is possible approximately to calculate the tensile strength.

Melting Practice in the Iron Foundry, with Special Reference to the Shaft Furnace.

BY JOHANN MEHRTENS, of Berlin.

[*Abstract.*]

Having referred at the outset to the ever-increasing severity of the calls made upon cast iron with regard to chemical composition and properties, the speaker described the measures the foundryman must take to meet these requirements in a fashion in keeping with the peculiarities of the given material and the practice obtaining in his establishment. In this connection he proposed to consider more especially the demands of present-day makers of machines and engines. If the founder could not meet the customers' requirements, he ran the risk of seeing more and more orders diverted to the steel and malleable foundries.

To cope with this danger, a movement was now on foot making for proper valuation and use of raw and auxiliary material, and including the question of new delivery-conditions for castings. To establish these principles, extensive experiments and investigations had been made already in German foundries, and the promoters of the Foundry Exhibition held last September in Düsseldorf had published an exhaustive report covering these activities.

In the first place, attention must be paid to the chemical composition of cast iron for given purposes. It was the foundryman's duty to go by analysis and so make proper use of whatever material was at his disposal, while at the same time he had to keep an eye on the possibility of controlling the charge in the actual process of melting. The value of mixing the raw material by analysis lay not only in increased certainty as to the composition of the resulting product, but also in the possibility it offered of using cheaper material and so effecting economies in melting practice.

The speaker then touched upon earlier attempts to arrive at uniform standards for cast iron, and mentioned a new proposal by the German Standards Committee, which had already been discussed in several German foundry manuals and seemed likely to give an impetus to the further development of the movement.

The provisional scheme covers some 20 varieties or classes of castings, and particularly "machinery castings." Ordinary machinery castings, it is proposed, in the first instance, to divide up into three general groups, viz., soft, medium-hard, and hard. The speaker discussed the three groups at some length, and in the course of his remarks he touched on the question of attaining higher strength by suitable control of the carbon-content and of quantity, nature and distribution of graphite, in which connection he made reference to recent work by well-known specialists.

Passing from the ordinary material for machinery castings, the speaker turned to "special" cast iron, destined to comply with the most exacting requirements as to strength, density and machinability. Every step in the practice of an up-to-date foundry should, as it were, leave its mark on this special product. He deprecated the use of the term "semi-steel" for this product, and pointed out that even the Americans were content to call it "special" or "high duty" cast iron.

As regards the classification of special cast iron, it was proposed that it be based upon low, medium and high tensile figures respectively, thus bringing it into line with the soft, medium-hard and hard groups proposed for the ordinary material. In this connection it was pointed out that a cast iron of lower tensile strength but greater density and easier machinability could also be looked upon as "special" cast iron. In any case, the quality of the material should have some say as to the class in which it was to be placed.

The speaker then discussed the effect of melting in the shaft-furnace on the quality of cast iron, declaring that, as a matter of fact, the old cupola or shaft-furnace still maintained its position as being the simplest and cheapest melting device in the iron foundry. This led to some remarks on recent improvements on the shaft-furnace, including the Schurmann furnace, the electric furnace and Wust's oil-fired furnace, and on the Foundry Exhibition at Düsseldorf.

Shaft furnaces, if they were to work economically, required careful tending. Many foundries failed in this respect, and the "Guiding Principles in Melting Practice" drawn up by the speaker at the Düsseldorf Exhibition should be of service in the training of furnace workers and works officials.

Attention was then drawn to processes for the improvement of cast iron, with particular reference to the Dürkopp-Luyken-Rein method, which uses an overflow level between the shaft and forehearth as well as a slagbox. Other inventions of this class were touched on, including the results achieved by processes using electric and oil-fired furnaces, and mention was made of the Lanz and Thyssen-Emmel methods. Thereafter the speaker referred to the necessity of teaching the moulder how to go about casting special material in the correct fashion.

In conclusion, a few remarks were made regarding the part to be played by the designer, whose aim must be to furnish drawings showing due appreciation of the problems involved in mould-making, casting and fettling.

A Useful Daubing for Cores.—Mix dry or stiff blacking with fine parting sand, in equal parts, and moisten with clay wash. Wet the edge of the core joint with a small camel-hair brush dipped in thin blacking, rub in the daubing and sleek it off level with the core body. Allow this to stiffen a little, and then black over the line of the joint with a sufficient quantity of thin blacking. This daubing is recommended for large and medium cores.

Discussion on Mr. R. W. Kemlo's Paper on "Patternmaking and Its Relation to Design and Foundry Practice."

The author was introduced by Mr. S. G. Smith, the newly-elected President of the Branch. Mr. Smith observed that for 16 or 17 years he had been closely associated with Mr. Kemlo, who was the general foreman patternmaker at the Metropolitan-Vickers Works, Trafford Park, Manchester. This Paper was both interesting and practical. His own opinion was that the Institute did not get sufficient of such Papers. Very often the brains of the foundry were located in the pattern shop, and he hoped other members whose work carried them there would give to others the benefit of the knowledge and experience they acquired.

MR. T. MAKEMSON, in proposing a vote of thanks to the author, expressed agreement with Mr. Smith that the Institution Papers did not touch as frequently as they ought to do on the patternmaking side of the industry.

MR. T. W. MARKLAND, who seconded the vote of thanks, insisted there should be co-operation and consultation between the foundry and the pattern shop.

MR. MARLOW said it had been suggested that the moulder might learn to read a drawing. That would be beneficial, but he would add another suggestion, that the pattern maker might learn to say exactly what he wanted. He had known cases where engineers and draughtsmen had conscientiously tried, but failed, to meet the wishes of the men who had the work to do.

Iron Patterns and Sand Adherence.

MR. A. SUTCLIFFE said he made some very large tun-dishes, the smallest of which was 5 ft. long, 4 ft. 2 in. wide, and 4 ft. 2 in. high; three patterns in all, but all different sizes. They were made from an iron pattern half an inch thick. They made the first one on the floor in a box; there were preparations on each side of the body, and it was lifted with grids. It was so fixed that there was no chance of loosening the pattern. The first one was a failure, as it adhered to the pattern, which had been washed overnight with lant and sal-ammoniac. He desired information as to what was put on to iron patterns to stop them from sticking to the sand. He had overcome the trouble on the second pattern with a proprietary paste called Klag-no-More.

MR. KEMLO replied that they did not put on any preparation to prevent clogging, or sticking, but they had experimented with a paint on the patterns to keep them from rusting when they were stored away outside the foundry. The trouble referred to did occur with new metal patterns, but soon goes off in use, and it will be found that the patterns work better when slightly rusty. A waxed brush is often used by the moulder to prevent clogging. With regard to the crank spindle and double centre, he said it all depended on the conditions. If what was commonly known as an eccentric spindle was used, it was necessary to have it made for certain diameters. It was necessary to have a number, in order to have a range over different diameters, and it was satisfactory. The works with which he was associated used them every day; double centres were only used when the others were not suitable or not available. They used the eccentric spindle for a very big job. Of course, it was necessary to use double centres, which were more rigid, for large work.

Shellac and Sticking.

MR. PRIMROSE said he did not know whether Mr. Kemlo had much experience of sand sticking to the full patterns, which were finished off with ordinary shellac varnish. He had tested various traveller's samples of shellac which were all guaranteed not to stick, and yet many of the patterns treated with them had drawn away much sand. Had the author any preference in the matter of proprietary mixtures for preventing sticking of sand to the finished pattern?

MR. KEMLO replied that he had no preference at all for any proprietary article. He had known about the sticking previously, and had got into trouble for making patterns too smooth. His experience was that nowadays people had not time to varnish. In his opinion, there was nothing superior to good sound shellac varnish, the purer the better, but it must be given time to set. Even when they went to the trouble to varnish, many patterns went quite yellow through the sand being damp and the varnish not drying.

MR. H. SHERBURN remarked that Mr. Kemlo had emphasised the question of allocating responsibility. People in charge of foundries seemed to be held responsible for so many things that one could quite appreciate a desire to be considered unable to read drawings, even if it were actually the case. In connection with some difficult castings it was a tall order to ask a man to take full responsibility for making an article in a certain way in the initial stage. From the patternmaker's point of view, naturally it would be a good thing, as it would relieve him of responsibility, but there were unforeseen difficulties attached to much of the work, and it would be a little unfair entirely to saddle the foundry with them. Some jobs were in the nature of experiments, and it was asking a good deal of the foundry foreman to ask him to say, "Make it that way, and I will take the responsibility." People in charge of foundries were frequently unable to visualise anything, unless it was in the concrete; as soon as they saw the pattern they could tell whether it was wrong, but they would not commit themselves in the matter in the drawing stage.

MR. KEMLO agreed that the question of the allocation of responsibility was a difficult one. He himself had given instructions for patterns to be made in a certain way; and when the work had been done he was inclined to ask, "Why did you make it that way" Some years ago they were making a core box, and after three or four had been on the job they finally decided to make it in a certain way which was considered to be the best. An apprentice came up and said, "Could we not have made that job so and so?" He (Mr. Kemlo) looked at it and said, "Who told you that?" to which question the boy replied, "I was only thinking about it." Thereupon he (Mr. Kemlo) remarked, "Yes, my lad, and it will be made that way." As a result, the whole thing was knocked to pieces and they started afresh. That was an indication that a man could be kept on a job until his mind ran in one groove, and he could see only one way of doing a thing; then someone else came along and pointed out how it could be done in a different way to advantage. It was their practice to consult with the moulders before a job was carried through; and they had found when that course was adopted better results were got and fewer complaints were received.

Co-operation.

The CHAIRMAN (Mr. S. G. Smith) said the author stressed the point of co-operation. His own view was that it could be carried much further than it had hitherto been done. If there were co-operation between foundry, pattern shop, drawing office and the engineers' office it was better for all parties; there would be less misunderstanding, and much time and money were saved.

With regard to moulders being unable to read drawings, many of those employed where he was engaged were able to do so, but it was often necessary for the patternmaker to be in the foundry in order to see that the cores were in the right position. Those young moulders who were now attending evening classes were getting instructions in the reading of drawings.

Camber was always a puzzle, and it would be a long time before it was standardised. Much had been said lately about standardisation, and probably it could be applied to a good many things in the foundry, but in his opinion standardisation to some extent meant stagnation. People got into a certain groove, and never quitted it. A foreman moulder or patternmaker who was worth his salt was always looking for some better means of getting through his work more quickly and doing it more cheaply. It was not really possible to standardise everything in the foundry.

Another speaker remarked that he was impressed with the emphasis Mr. Kemlo laid upon the fact that patternmakers were producers. At his place they were often looked upon as necessary evils.

Provision of Models.

MR. PRIMROSE said he wished to put one point to Mr. Sherburn. A local engineering works, where the firm had not a foundry of their own, but relied upon outside founders to produce the castings required, had found it useful when an intricate design had to be produced, to make an accurate model, one-tenth the normal size of the finished article. That model went out along with the drawings, in order that the patternmakers and the moulders might visualise what was going to be produced, and the means to be taken in the way of special moulding precautions to get correct the machining and fitting parts. In his view that was a very admirable idea. It might cost a little to begin with, but it saved considerable trouble in the end.

The CHAIRMAN remarked that it was not an unknown thing for foremen patternmakers to have a model in addition to the drawings, so as to see what the job would look like when finished.

MR. SHERBURN said the difficulty, as anyone connected with a pattern shop knew, was that the getting out of new designs took up so much time that as soon as the drawings got to the pattern shop it was full speed ahead. He believed that only in one case out of a thousand would anyone be prepared to incur the loss of time involved by the making of a complete model, without taking into account the expense it involved. Admirable though the practice was, the main question was one of time. Every pattern shop promised its patterns in a certain time, and the actual delivery of the complete machines was also often promised long before actual operations on the patterns were commenced.

MR. KEMLO, referring to Mr. Primrose's remarks about the model one-tenth the size of the finished article, said that was not uncommon, but it could be carried to a ridiculous length by making models of everything that was wanted. It was necessary in exceptional cases only. He had in mind a case where a new design in turbine cylinders was being produced. The drawings sent to him would have filled a long table from end to end. An opinion was expressed that the thing could not be made, but it was decided to make a model to see what it was like; and when that had been done it was found that to say it could not be made was ridiculous. The work was simplified. Not only was a model made of the cylinder, but also of the cores, which were put together and then cut into sections as they would be made to place in the moulds.

There were other points which he might have touched upon, such as machining allowance—what allowance ought to be made for the machining? That was often a cause of worry in the pattern shop. There was also the question of allowance in the sizes of the core boxes. Some sands swelled in drying, and others shrank.

The question of the storing of patterns was a great problem. They had acres of ground covered with patterns. The difficulty was to get the engineers to scrap them when they were done with, and they lay in the yard for years. The overhead charges in that connection became very great.

Estimating Weights and Waste of Time.

A meeting, held under the auspices of the American National Committee of the Department of Commerce on the Utilisation of Metals insisted that the wasteful practice of submitting blueprints to foundries without first indicating the weight thereon is wasteful, and a Committee was appointed to consider the matter and to report to the Detroit International Congress. Mr. R. E. Belt, of the American Malleable Castings Association, estimated that £1,000,000 a year was lost to the American foundry industry through the time wasted in calculating weights.

Standardisation in Drawing Office and Pattern Shop.

BY J. M.

The American Engineering Standards Committee have recently launched a comprehensive programme of standardisation of drawing office practice, and it has been insisted that this will result in a more ready understanding of drawings by everybody for whom they are intended. The writer, speaking from experience of the drawing office as well as the workshop, does not subscribe to this view. Standardisation may be possible in the drawing office, although he doubts it, but it would not make for cheaper production in the shops.

The pattern shop is invariably the first shop to receive a drawing, and the drawing is accurately read, whatever the arrangement of views of sections, the methods of indicating dimensions, etc.

It is only when a drawing is insufficiently dimensioned that there is a loss of time in the pattern shop; the rule may be used on the drawing, and, if it is a scale drawing, a wrong dimension may be obtained. Blue prints especially should never be "scaled," as they shrink in drying. In some pattern shops there is a wise rule that under no circumstances must a size be lifted from the drawing unless and until it has been dimensioned. It is difficult to see how standardisation in the drawing office could get over this. It would be helpful, however, if there were universally recognised methods of marking machined surfaces. Then drawing offices do not always use thumb-nail sketches as they might do. One suggestion may be made here, which is that when the usual drawing is sent down to the pattern shop it should be accompanied by a picture view or an isometric view of the casting required. The experienced patternmaker can visualise any casting after he has carefully studied the drawings, but all have not had the necessary experience, and, in any case, much time would be saved. The patternmaker must visualise the object before he can make it; in some cases where the design is exceedingly intricate, with difficult coring, a model may be considered necessary. It does happen occasionally that the draughtsman requires a model because he cannot visualise a casting, but this is not often.

Standardisation in the drawing office would not overcome the practice in some works of sending down preliminary drawings which are little more than rough sketches; it would not get over the repeated altering of drawings in the shops while the work is proceeding.

How is standardisation of patternmaking practice possible? In one district, for a particular type of casting, a skeleton pattern will be made, while in another district the casting will be obtained from a block pattern and corebox. The patternmaking methods are decided by the moulders' requirements, and as there is no standardisation in the foundry, moulding methods differ in various districts. As long as patternmaker and moulder co-operate and have a complete understanding, standardisation does not seem to matter. One method of production may mean more work in the pattern shop and less in the foundry, while another method will give most work to the foundry; it is the final production cost of the casting that really matters.

Each pattern shop can adopt its own standardisation methods. In some jobbing pattern shops work is divided into first and second classes, the best class being for repetition work. In large shops doing a variety of large and small work there should be three classes. First-class patterns would be filleted, painted and varnished, loose pieces would be carefully dovetailed and the construction would be of the strongest. Such patterns would be for repetition work. The second-class pattern would be strongly made, but not as much attention would be paid to finish; cheaper constructional methods might be adopted, because a comparatively few castings would be required and the pattern would probably never be required again. The third class would be for the cheapest one-off jobs.

Trade Talk.

THE GERMAN PIG-IRON SYNDICATE have decided not to make any change in the iron prices or terms of sale for June.

JOHN I. THORNYCROFT & COMPANY, LIMITED, of Southampton, have secured an order to build a twin-screw motor tanker for Anglo-Ecuadorean Oil Fields, Limited.

A RESUMPTION OF WORK took place on May 24 at the Clydesdale Steel Works, Mossend, of Stewarts & Lloyds, Limited. Several furnaces were lit at the week-end, and operations have been started at the plate rolling mill.

SCOTTS' SHIPBUILDING & ENGINEERING COMPANY, LIMITED, Greenock, have obtained an order from the Straits Steamship Company for a small single-screw steamer. The firm are at present engaged on the construction of four steamers of 8,500 tons each for London owners.

THE CLYDE CRANE AND ENGINEERING COMPANY, LIMITED, have obtained a contract from the South African Railways for the supply of patent level luffing harbour cranes. The order is one of the largest which has been placed in this country for this particular type of crane for some considerable time.

SIR W. G. ARMSTRONG, WHITWORTH & COMPANY, LIMITED, have an order from the Crown agents for the Colonies for the conversion of eight 4-8-0 engines into 4-8-2 engines for the Nigerian railways. Sir W. G. Armstrong, Whitworth & Company, Limited, have also secured an order for 20 boilers for 0-6-0 type locomotives for the London & North-Eastern Railway.

THE EXECUTIVE COUNCIL of the Society of Technical Engineers has issued the terms of a Bill for the registration of engineers. For the purposes of the Act there is to be established the General Council of Engineering, constituted as follows:—(*a*) Four persons, not being engineers, appointed by the Privy Council, one each resident in England, Scotland, Wales and Northern Ireland respectively. (*b*) Four persons, who shall be engineers attached to the following services:—The Royal Navy, the Royal Engineers, the Royal Air Force, and the mercantile marine, one each appointed respectively by the First Lord of the Admiralty, the Secretary of State for War, the Minister for Air, and the President of the Board of Trade. (*c*) Sixteen persons, who shall be engineers, elected as follow:—Four by the statutory councils of each of the following institutions: The Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Naval Architects, and the Institution of Electrical Engineers. (*d*) Not more than six persons, who shall be engineers, elected by the statutory council or councils of such other institution or institutions, if any, as the General Council may determine ought to be represented. (*e*) Six persons, who shall be engineers, elected by the council of the Association of Technical Institutes. (*f*) Six persons, who may or may not be engineers, elected by the Deans of the Faculties of Engineering of the Universities of Great Britain and Northern Ireland; provided that in the case of a University which has no Faculty of Engineering, the general council shall determine how such University is to be represented in the election. (*g*) Not more than four persons, who may or may not be engineers, elected as follow:—Two by the Board of the Engineering and Allied Employers' National Federation, one by the Committee of the Association of Consulting Engineers, and one by the executive council of such other organisation of engineering employers, if any, as the General Council may determine ought to be represented. (*h*) Not more than four persons, who shall be engineers, elected as follow:—One by the council of the Society of Technical Engineers, one by the council of the Electrical Power Engineers' Association, and one each by the executive council or councils of such other organisation or organisations of engineering employés, if any, as the general council may determine ought to be represented. It will be the duty of the general council to fix the qualifications entitling persons to registration under the Act; to keep a register of such persons, and to publish annually lists of the names and addresses of registered engineers, together with such information regarding their qualifications as it may determine. In fixing the qualifications for registration under the Act, the general council, in addition to determining the standard of examinations required for registration, shall also determine as far as possible what practical qualifications shall be required, such as: (*a*) An engineering apprenticeship; or (*b*) at least three years' practical experience of some form of engineering work; or (*c*) two years at least in a responsible position such as pre-supposes the possession of a practical knowledge of engineering; or (*d*) the service of articles to a registered member of an institution represented on the general council; or (*e*) such other practical experience as the general council may determine.

Personal.

MR. H. HARTLAND, after 24 years' service at the Norton Works of Robert Heath and Low Moor, Limited, has ben appointed works manager of the Knutton Iron and Steel Company, Limited, Newcastle.

MR. D. A. PALMER, lately managing director of Fuller's United Electrical Works, Limited, of Chadwell Heath, has been appointed general manager of Joseph Rodgers & Sons, Limited, Norfolk Street, Sheffield.

MR. S. HAMPSHIRE, manager of the spring department, was the recipient of a presentation from the management and staff at the Stocksbridge iron and steel works of Samuel Fox, Limited, recently, the gift being handed over by Dr. T. Swindon, works manager. Mr. Hampshire, who is leaving the firm to take up an appointment at E. Cottam & Company, Limited, Rotherham, has been with the Stockbridge firm for 40 years, and for 16 years has been in charge of the spring department.

Wills.

DEELEY, J. G., of Clarendon Road, Edgbaston, Birmingham, ironfounder £7,025

NEWMAN, E. J., of Birmingham, chairman and managing director of William Newman & Sons, Limited, brassfounders and spring manufacturers £49,437

LLOYD, A. Ll., Atlas Works, Spring Hill, Birmingham, and of Catton Lodge, Leamington, chairman of Piggott & Company, Limited, and a director of the Mint (Birmingham), Limited £73,273

Contracts Open.

Auckland, N.Z., June 24.—Cast-iron pipes, valves, hydrant pieces, hydrants, hydrant boxes, etc., for the Auckland City Council Waterworks Department. The Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (Reference A.X. 3131.)

Buenos Aires, June 15.—10,000 wheels with steel disc centres, for the Argentina State Railways. The Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (Reference A.X. 3111.)

Cairo, June 21.—Supply and laying down of water pipes in the town of Sembellawein, for the Municipalities and Local Commissions Section, Cairo. The Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (Reference A.X. 3125.)

Dublin, June 15.—180 fathoms of 1⅛-in. stud link ships' cable chain, fully conforming to Lloyds' requirements for this size, for the Dublin Port and Docks Board. The Engineer's Office, East Wall, Dublin.

Durban, June 11.—Steel straight pipes and fittings, for Durban Corporation. The Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (Reference A.X. 3117.)

Durban, June 11.—Cast-iron pipes and specials (Contract W.78), for the Borough of Durban. The Department of Overseas Trade, 35, Old Queen Street London, S.W.1. (Reference A.X. 3124.)

Rothwell, June 7.—430 yds. 4-in. cast-iron spigot and socket water mains; 430 yds. 4-in. weldless steel spigot and faucet tubing, etc.; for the Urban District Council. Mr. A. Tyldesley, clerk, Council Chambers, Rothwell, near Kettering.

New Companies.

A. and B. Harris, Limited.—£5,000 in 10,000 ordinary shares of 2s. and 4,000 8 per cent. preference shares of £1. Engineers. Directors: A. E. Harris, 19, Russell Square, W.C.1; and B. A. Harris.

Frederick Parker, Limited.—Capital £20,000. Engineers and ironfounders. Directors: F. Parker and Mrs. I. V. Parker, both of Rosemount, Uppingham Road, Leicester.

Harris & Lord, Limited, Protector Foundry, Tipton, Staffs.—Capital £100. General ironfounders, etc. Director: H. C. Harvey.

New Garter Foundry (1926), Limited, Groveland Road, Dudley Port, Tipton.—Capital £10,000. Manufacturers of brass, iron and steel, etc.

THE WOODALL-DUCKHAM VERTICAL RETORT AND OVEN CONSTRUCTION COMPANY (1920), LIMITED, have an order from the Deal and Walmer Gas Company for the supply of an installation of continuously-working vertical retorts, having a carbonising capacity of 49 tons per day. The installation will be complete with the necessary coal- and coke-handling plant, coke storage hoppers and screen, and waste-heat boiler.

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IRON AND STEEL MARKETS.

Pig-Iron.

MIDDLESBROUGH.—As might be confidently expected in the prevailing conditions, business in the Cleveland iron market during the current week has been practically a dead letter, and, although a few of the foundries and engineering works continue in operation, home demands are readily met from stocks remaining in makers' yards. There is still, however, a certain amount of export trade possible, and a number of cargoes held up during the local dock strikes has been despatched. Meanwhile, the manufacture of pig-iron has ceased on Tees-side, with the exception of one or two "sick" furnaces, which have to be kept going if at all possible. Such stocks of foundry iron as there are are being generally depleted, and unless the miners' strike is settled before very long, conditions of absolute stagnation must ensue. For iron still available makers' prices are firm at 72s. 6d. per ton for No. 3 G.M.B., while 76s. is required for No. 1, 71s. 6d. for No. 4 foundry, and 71s. per ton for No. 4 forge.

Apart from a few occasional transactions, there is practically no business passing in hematite. All the furnaces are quiet, but there are considerable quantities of stock on the ground. With the steelworks idle, however, the inquiry for hematite is merely nominal. Mixed numbers are obtainable at about 77s. 6d. per ton. On the North-West Coast prices are unchanged, with Bessemer mixed numbers quoted at £4 2s. 6d. c.i.f. Welsh ports, £4 5s. to £4 7s. 6d. per ton delivered at Glasgow, £4 8s. to £4 10s. per ton delivered at Sheffield, and £4 15s. to £4 16s. per ton delivered at Birmingham.

LANCASHIRE.—In this area makers of foundry pig holding stocks—and in no case are they heavy—are husbanding them very carefully, most of them restricting sales to regular users of their particular makes. There is, however, no doubt of the firmness of the market, and all pig-iron producers who are willing to quote are holding for the increase. Staffordshire, Lincolnshire and Derbyshire No. 3 are all round 77s. 6d. delivered Manchester.

THE MIDLANDS.—The story of idle furnaces and diminished stocks is repeated also in South Staffordshire and the neighbouring districts, and shortly there will be no iron available for consumers. Makers consequently have been able to command better figures for the stocks they held, and Derbyshire No. 3 is quoted at 70s. at furnaces and Northampton at 66s. North Staffordshire No. 3, what limited quantity has been sold, has been in the neighbourhood of 70s. also. The ironfounders are carrying on as best they can, but fuel has now become extremely scarce, and high prices are being asked for available supplies.

SCOTLAND.—The number of blast furnaces in operation in Scotland is now down to five, and it is anticipated that these will not long remain working. With the production down to such small dimensions, prices are firmer, and some makers have advanced their quotations as much as 2s. per ton. The nominal quotation for No. 3 Scotch foundry now is 77s. 6d. for furnaces.

Finished Iron.

In the conditions applying in the pig-iron industry above outlined, business in the manufacturing departments is naturally similarly affected, and very few works are able to continue in operation. There has been no alteration in the prices of finished material, and £11 to £11 5s. per ton is the figure being asked for crown-quality bars. Nut and bolt iron is quoted between £9 15s. and £10 per ton, but little business is being given out, and during the last fortnight a considerable tonnage has been placed with Continental works for this class of iron, because of the extremely low prices which have been prevailing. At the present moment £4 15s. to £4 17s. per ton f.o.b. Antwerp is quoted, which would give a figure delivered here of £5 15s. to £5 17s. From this it will be seen what a disparity there is between the English and Continental price, and it is quite impossible for the home producers to do anything in the way of competition. There has been a fair amount of business sent through to the ironworks for the better qualities of iron, but little tonnage is being turned out at this juncture. There is also a fair demand for iron tube strip, the basis price for which is £12 10s. per ton. Marked bars continue to be quoted at £14 per ton at makers' works, which figure has been operative since December last.

Steel.

Conditions in the steel industry are quiet, and are just as hopeless as in other branches requiring large supplies of fuel. The only mills running lately have been those using imported billets, and even these cannot carry on much longer for want of fuel. In the circumstances, it is very difficult to know what to say about prices. Those recently ruling may be quoted, with the proviso that in the last week or two most of the business has been done by merchants at a premium. In the tinplate trade the Briton Ferry works and the bar-rolling mills at the Llanelly works of Richard Thomas & Company, Limited, are still operating, but the melting shops of the other steelworks and the mills at the tinplate works are idle. Tinplates continue to be quoted at 19s. 1½d. to 19s. 6d. basis, IC, f.o.b. works' port, but business is very limited, and shipments are delayed by the restrictions on bunker coals.

Scrap.

Business in the various markets for scrap metal is at the moment practically non-existent, increasing difficulty being experienced in obtaining fuel supplies and rapidly curtailing consumers' operations. During the past week transactions in this class of material in Lancashire have necessarily been few and far between, but some occasional lots of textile machinery scrap have changed hands at about 70s., with ordinary qualities quoted 62s. 6d. to 65s. per ton, delivered equal Manchester.

Metals.

Copper.—Throughout the critical period of industrial disturbance experienced in the past month, an outstanding feature of interest has been the entire absence of panic symptoms, with the accompanying wild fluctuations in values usually observable in the metal markets in abnormal times. Standard copper, for example, has maintained a confidently steady tone, with quotations seldom varying beyond a range of £56 7s. 6d. or thereabouts. Current quotations :—*Cash* : Thursday, £56 2s. 6d. ; Friday, £56 5s. ; Monday, £56 5s. ; Tuesday, £56 5s. ; Wednesday, £56 5s.

Three Months : Thursday, £57 ; Friday, £57 2s. 6d. ; Monday, £57 2s. 6d. ; Tuesday, £57 2s. 6d. ; Wednesday, £57 2s. 6d.

Tin.—Consequent upon the general disruption of business arising from labour troubles, the market for standard tin has developed a weaker tendency in values, and during the month just closed has dropped some £8 from quotations current at the end of April. The home demand has been exceedingly poor, while American business has fallen off again, and very little has been doing with the Continent. No little uneasiness was caused by the assumption that smelting operations in this country might become seriously affected by the national disturbances whereby the scarcity of home supplies is apt to be aggravated, but, fortunately, home smelters have been able to keep operations going so far. Current quotations :—*Cash* : Thursday, £267 15s. ; Friday, £268 10s. ; Monday, £267 ; Tuesday, £266 ; Wednesday, £262 15s.

Three Months : Thursday, £267 15s. ; Friday, £267 10s. ; Monday, £265 10s. ; Tuesday, £264 10s. ; Wednesday, £261 15s.

Spelter.—Imports of zinc during the month of April totalled 12,667 tons, and for the four months 59,024 tons, compared with 12,027 and 47,304 tons respectively in the corresponding periods of 1925. It was thought possible that the revolutionary movement in Poland might interrupt supplies from that country, but this does not appear to be the case, and, on the whole, the London market has ruled very steady. There is, however, little consumptive business and ready offering from the Continent. Current quotations :—*Ordinary* : Thursday, £31 17s. 6d. ; Friday, £32 ; Monday, £32 ; Tuesday, £32 3s. 9d. ; Wednesday, £32 6s. 3d.

Lead.—Soft foreign prompt pig-lead has derived some little benefit from the fact that certain consignments which were originally intended for this country were diverted to Continental ports, where better terms were obtainable than in our market. Consumers have bought but little pending a resumption of operations after the strike, but, on the other hand, oversold dealers covered themselves, which contributed to the firmness of the market. Current quotations :—*Soft foreign (prompt)* : Thursday, £28 10s. ; Friday, £28 12s. 6d. ; Monday, £29 ; Tuesday, £29 3s. 9d. ; Wednesday, £29 10s.

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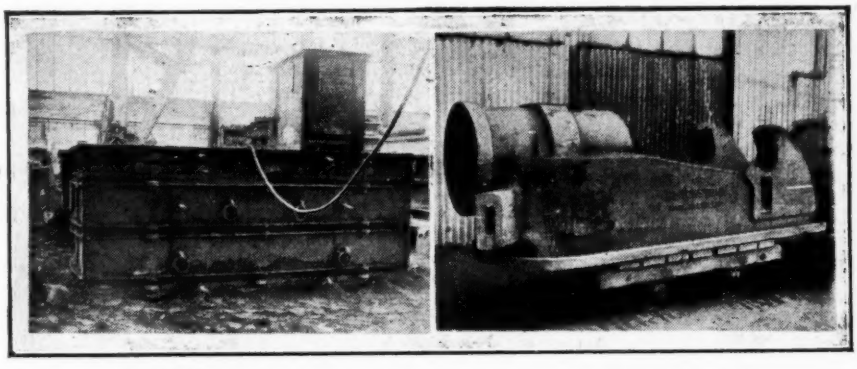

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Do. June	64	5	0
Do. July	64	5	0
Ingot bars	64	5	0
H.C. wire rods ..	68	10	0
Off. av. cash, May	56	11	1½
Do., 3 mths. May	57	8	10½
Do., Sttlmnt, May	56	10	4½
Do., Electro, May	64	10	10½
Do., B.S., May ..	60	14	4½
Aver. spot price copper, May ..	56	10	4½
Do., wire bars, May	64	15	6
Solid drawn tubes		12½d.	
Brazed tubes ..		12½d.	
Wire		9½d.	

BRASS.

Solid drawn tubes ..	11½d.
Brazed tubes	13½d.
Rods, drawn	10½d.
Rods, extd. or rlld. ..	7½d.
Sheets to 10 w.g ..	10½d.
Wire	9½d.
Rolled metal	9½d.
Yellow metal rods ..	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets ..	8½d.

TIN.

	£	s.	d.
Standard cash ..	262	15	0
Three months ..	261	15	0
English	261	0	0
Bars	265	10	0
Straits	274	0	0
Australian	266	12	6
Eastern	270	10	0
Banca	268	10	0
Off.aver. cash, May	270	5	0¾
Do., 3 mths., May	266	14	5½
Do., Sttlmt. May	270	4	9
Aver. spot., May	270	4	9

SPELTER.

	£	s.	d.
Ordinary	32	6	3
Remelted	32	5	0
Hard	27	0	0
Electro 99.9 ..	35	7	6
English	32	15	0
India	30	0	0
Zinc dust	42	0	0
Zinc ashes	14	10	0
Off. aver., May ..	32	4	6
Aver., spot, May	32	0	9

LEAD.

	£	s.	d.
Soft foreign ppt.	29	10	0
English	30	15	0
Off. average, May	28	9	8⅝
Average spot, May	28	5	0

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	41	0	0
Do. V.M. ex whf.	38	0	0
Rods	44	0	0
Boiler plates ..	38	10	0
Battery plates ..	38	0	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	84	10	0
Chinese	60	0	0
Crude	40	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver ..	15	10	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon	
25%	9 10 0
45/50%	11 5 0
75%	20 5 0
Ferro-vanadium—	
35/40%	14/6 to 15/- lb. va.
Ferro-molybdenum—	
70/75% c. free	6/3 lb.
Ferro-titanium—	
23/25% carbonless	11½d. lb.
Ferro-phosphorus, 20/25%,	£17 0 0
Ferro-tungsten—	
80/85%,c.fr. ..	1/7½ lb.
Tungsten metal powder—	
98/99%	2/- lb.
Ferro-chrome—	
2/4% car. ..	£33 10 0
4/6% car. ..	£22 5 0
6/8% car. ..	£21 15 0
8/10% car. ..	£20 17 6
Ferro-chrome—	
Max. 2% car.	£37 0 0
Max. 1% car.	£43 10 0
Max.0.70%car.	£54 10 0
70%,carbonless	1/5½ lb.
Nickel—99%, cubes or pellets ..	£170
Cobalt metal—98/99%	10/- lb.
Aluminium 98/99%	£112
Metallic Chromium—	
96/98% ..	3/3 lb.
Ferro-manganese (net)—	
76/80%, loose	£15 0 0
76/80%, packed	£16 0 0
76/80%, export	£14 5 0
Metallic manganese—	
94/96%, carbonless	2/- lb.
Per ton unless otherwise stated.	

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten ..	2	6
Finished bars, 18% tungsten ..	3	0
Per lb. net, d/d buyers' works.		
Extras—		
Rounds and squares 3 in. and over ..	4d.lb.	
Rounds and squares under ¼ in. to ¼ in.	3d. lb.	
Do. under ¼in. to ⅞ in.	1/- lb.	
Flats, ¼in. × ¼in. to under 1 in. × ⅛ in.	3d. lb.	
Do. under ¼in. × ¼in.	1/- lb	
Bevels of approved sizes and sections	6d. lb.	
Bars cut to length	10% extra	
Scrap from high-speed tool steel—		
Scrap pieces	3d.	
Turnings and swarf	1d.	
Per lb. net, d/d steel makers' works.		

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Hvy. steel	3	7	6 to 3	10	0	
Bundled steel & shrngs.	3	3	0 to 3	6	0	
Mixed iron & steel	3	0	0 to 3	3	6	
Heavy cast iron	3	2	6 to 3	5	0	
Good machinery for foundries ..	3	7	6			
Cleveland—						
Heavy steel ..	3	1	0			
Steel turnings ..	2	6	0			
Cast iron borings	2	5	0			
Heavy forge ..	4	2	6			
Bushelled scrap	3	10	0			
Cast-iron scrap	3	6	0			
Lancashire—						
Cast-iron scrap	3	5	to 3	10	0	
Hvy. wrought ..	3	5	0			
Steel turnings ..	2	2	0			
London — Merchants' buying prices delivered yard.						
Copper (clean)..	48	0	0			
Brass (clean) ..	38	0	0			
Lead (less usual draft)	25	10	0			
Tea lead ..	21	0	0			
Zinc	21	0	0			
New aluminium cuttings ..	80	0	0			
Braziery copper	44	0	0			
Gunmetal ..	44	0	0			
Hollow pewter	170	0	0			
Shaped black pewter ..	126	0	0			

PIG-IRON.

(f.o.t. unless otherwise stated).

N.E. Coast—	
Foundry No. 1 ..	76/-
Foundry No. 3 ..	72/6
Foundry No. 4 ..	71/6
Forge No. 4	71/-
Hematite No. 1 ..	77/9
Hematite M/Nos. ..	77/3
N.W. Coast—	
Hem. M/Nos. d/d Glas.	86/3
,, d/d Birm.	95/6
Midlands—	
Staffs common* ..	—
,, No. 4 forge ..	—
,, No. 3 foundry	69/6
Shrops. basic	70/-
,, Cold blast, ord.*	185/-
,, ,, roll iron* ..	190/-
* d/d Birmingham.	
Northants forge	—
,, fdry No. 3 ..	66/-
Derbyshire forge ..	—
,, fdry. No. 3 ..	69/6
,, basic	—
Scotland—	
Foundry No. 1 ..	82/6
,, No. 3 ..	77/6
Hem. M/Nos.	76/-
Sheffield (d/d district)—	
Derby forge	—
,, fdry. No. 3 ..	73/6
Lincs. forge	67/6
,, fdry. No. 3 ..	70/-
E.C. hematite	89/3
W.C. hematite ..	89/-
Lincs. (at furnaces)—	
Forge No. 4	61/6
Foundry No. 3.. ..	64/-
Basic	63/-
Lancashire (d/d eq. Man.)—	
Derby forge	—
,, fdry. No. 3 ..	77/6
Northants foundry No. 3	77/-
Dalzell, No. 3	110/-
Summerlee, No. 3 ..	95/-
Glengarnock, No. 3 ..	95/-
Gartsherrie, No. 3 ..	95/-
Monkland No. 3	95/-
Coltness, No. 3	95/-
Shotts, No. 3	95/-

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars(cr.)	11	0	0 to 12	0	0	
Angles	11	10	0			
Tees to 3 united ins.	12	0	0			
Nut and bolt	10	5	0 to 10	7	6	
Hoops	14	0	0 to 15	0	0	
Marked bars (Staffs.) f.o.t. ..	14	0	0			
Gas strip	12	10	0			
Bolts and nuts .. ¾ in. × 4 in. ..	15	5	0			
Steel—						
Ship plates	7	12	6 to 7	17	6	
Boiler plts. ..	11	5	0			
Chequer plts. ..	9	15	0			
Angles	7	2	6			
Tees	8	2	6			
Joists	7	2	6			
Rounds and Squares 3 in. to 5½ ins. ..	7	15	0			
Rounds under 3 in. to ⅜ in.	7	10	0			
Flats, over 5 in. wide and up ..	8	5	0			
Flats, 5in. to 1½in.	7	5	0			
Rails, heavy ..	8	0	0			
Fishplates	12	0	0			
Hoops (Staffs.) ..	10	10	0			
Black sheets, 24g.	10	17	6			
Galv. cor. sheets, 24g.	15	12	6			
Galv. fencing wire 8g. plain	13	0	0			
Billets,soft	£6	2	6 to 6	5	0	
Billets, hard ..	8	2	6			
Sheet bars	6	0	0 to 6	2	6	
Tin bars d/d	6	2	6 to 6	5	0	

PHOSPHOR BRONZE.

	Per lb.	basis
Strip	1	1
Sheet to w.g.	1	3½
Wire	1	3½
Rods	1	3
Tubes	1	8
Castings	1	2

Delivery 3 cwt. free
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks ..	9d. to 1/5½
Ingots rolled to spoon size ..	1/- to 1/8½
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	22.76
No. 2 foundry, Valley	20.76
No. 2 foundry, Birm.	22.00
Basic	20.26
Bessemer	21.26
Malleable	20.76
Grey forge	20.26
Ferro-mang. 80% d/d	88.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	35.00
O.-h. billets	35.00
O.-h. sheet bars ..	36.00
Wire rods	45.00
	Cents.
Iron bars, Phila. ..	2.22
Steel bars	1.90
Tank plates	1.85
Beams, etc.	1.90
Skelp, grooved steel ..	1.90
Skelp, sheared steel ..	1.90
Steel hoops	2.50
Sheets, black, No. 28..	3.15
Sheets, galv., No. 28 ..	4.40
Sheets, blue an'l'd, 9 & 10	2.40
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv. ..	3.35
Tinplate, 100 lb. box	$5.50

COKE (at ovens).

Welsh foundry ..	32/6 to 40/-
,, furnace ..	20/- to 25/-
Durham & North.	
,, foundry	30/- to 33/-
,, furnace	14/- to 14/6
Other Districts, foundry	30/- to 33/-
,, ,, furnace (basis)	11/9

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes,	20×14, box	19/4½
,,	28×20, ,,	38/9
,,	20×10, ,,	29/3
,,	18¾×14, ,,	20/3
C.W.	20×14, ,,	17/4½
,,	28×20, ,,	35/-
,,	20×10, ,,	24/6
,,	18¾×14, ,,	18/3½

Terneplates 28×20, 36/9 per box basis f.o.b.

SWEDISH IRON.

Bars,hammered	£18/10 to £19/0
Rolled Ord.	£15/15/0 to £16/5/0
Nail rods	£16 5 0 to £16 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£9 to £12

Pig-iron £6 5 0 to £7 0 0 all f.o.b. Gothenburg.

TUBES AND FITTINGS.
Up to and incl. 6 in.

	Tubes	*Fittings*
Gas	60%	50%
Water	55%	45%
Steam	50%	40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (Cash).

	£	s.	d.	
May 27	56	2	6	dec. 2/6
,, 28	56	5	0	inc. 2/6
,, 31	56	5	0	No change
June 1	56	5	0	,, ,,
,, 2	56	5	0	,, ,,

Electrolytic Copper.

	£	s.	d.	
May 27	64	0	0	dec. 5/-
,, 28	64	0	0	No change
,, 31	64	0	0	,, ,,
June 1	64	0	0	,, ,,
,, 2	64	0	0	,, ,,

Standard Tin (Cash).

	£	s.	d.	
May 27	267	15	0	dec. 5/-
,, 28	268	10	0	inc. 15/-
,, 31	267	0	0	dec. 30/-
June 1	266	0	0	,, 20/-
,, 2	262	15	0	,, 65/-

Tin (English ingots).

	£	s.	d.	
May 27	265	5	0	dec. 10/-
,, 28	266	0	0	inc 15/-
,, 31	264	15	0	dec. 25/-
June 1	263	10	0	,, 25/-
,, 2	261	0	0	,, 50/-

Zinc Sheets (English).

	£	s.	d.	
May 27	41	0	0	No change
,, 28	41	0	0	,, ,,
,, 31	41	0	0	,, ,,
June 1	41	0	0	,, ,,
,, 2	41	0	0	,, ,,

Spelter (ordinary).

	£	s.	d.	
May 27	31	17	6	dec. 3/9
,, 28	32	0	0	inc. 2/6
,, 31	32	0	0	No change
June 1	32	3	9	inc. 3/9
,, 2	32	6	3	,, 2/6

Lead (English).

	£	s.	d.	
May 27	30	0	0	No change
,, 28	30	0	0	,, ,,
,, 31	30	5	0	inc. 5/-
June 1	30	10	0	,, 5/-
,, 2	30	15	0	,, 5/-

Exports of Iron Castings in April and the four months 1926, compared with April and the four months 1925.

	April, 1925	April, 1926	Four months, 1925	Four months, 1926	April, 1925	April, 1926	Four months, 1925	Four months, 1926
BUILDERS' CASTINGS—	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Stoves, Grates, etc., Cisterns, Baths, etc., and cooking and washing boilers—								
To Argentine Republic	98	67	512	463	3,533	2,394	17,934	17,688
,, British South Africa	323	383	1,227	1,718	10,231	11,701	43,968	56,907
,, ,, East Indies	121	133	568	604	5,808	6,551	28,957	28,554
,, Australia	65	77	300	386	3,557	5,161	16,468	21,798
,, New Zealand	283	189	963	923	13,658	8,615	45,788	44,409
,, Other countries	543	586	2,498	2,601	28,832	27,715	126,771	126,291
Total	1,433	1,435	6,068	6,725	65,619	62,137	279,886	295,647
PIPES AND FITTINGS—CAST—								
To Argentine Republic	1,415	1,253	3,681	3,282	17,541	16,543	48,617	42,645
,, British South Africa	756	593	2,338	2,179	9,418	9,091	31,828	36,110
,, ,, India	919	1,450	4,050	4,264	12,795	16,575	58,000	51,222
,, Straits Settlements & Malay States	341	3,346	2,466	9,091	4,459	25,377	27,569	73,735
,, Ceylon	56	172	500	1,100	902	1,946	6,589	12,066
,, Australia	370	308	1,120	2,040	5,136	3,900	16,940	26,258
,, Other countries	7,263	4,535	19,205	19,346	90,918	61,466	281,096	260,213
Total	11,120	11,657	33,360	41,602	141,169	134,898	470,639	502,249
HOLLOW-WARE—								
Cast, not Enamelled, and Cast, Tinned	653	512	3,066	2,530	21,681	18,132	97,233	85,969
,, Enamelled	50	71	365	306	5,939	7,453	34,848	32,825
CASTINGS, in the rough—								
Iron	69	150	422	597	2,968	4,371	16,934	17,037
Steel	44	26	163	341	1,621	1,072	6,032	9,389

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

18, BENNETTS HILL, BIRMINGHAM.
11, OLD HALL STREET, LIVERPOOL.
EXCHANGE BLDGS., PORT TALBOT.
FOWLERS BUILDINGS, BOMBAY.
CLIVE STREET, CALCUTTA.
ANGAPPA NAICK STREET, MADRAS.

REGISTERED TRADE MARK
LIMPET

1, HONG KONG ROAD, SHANGHAI.
OCEAN BUILDING, SINGAPORE.
JAVA STREET, KUALA LUMPUR
5, SHAFFRAZ ROAD, RANGOON.
COX'S BUILDINGS, KARACHI.
P.O. BOX 1580, CAIRO.

PIG IRON

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.,

NON-FERROUS METALS

COPPER, TIN. LEAD, SPELTER, ANTIMONY, CHROME ORE

WILLIAM JACKS & COMPANY,

19, ST. VINCENT PLACE, GLASGOW.

ZETLAND ROAD, MIDDLESBROUGH.

SITUATIONS VACANT AND WANTED.

PRACTICAL Steel Foundry Metallurgist desires position; could erect successful small steel plant, or invest limited amount with small firm; present position Steel Foundry Manager.—Box 714, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

AN All-round Foundryman desires position as Foreman; accustomed to heavy or light castings; expert knowledge of machine moulding and metal mixing.—Box 738, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FIRST-CLASS Engineer and Foundry Manager, proved competent Organiser and Administrator, late Manager of large modern Steel Foundry and Machine Shops, sound practical, technical and managerial experience, thorough personal knowledge of customers and requirements, would accept subordinate executive position and salary if both progressive, or undertake Representative; highest references.—Box 730, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WORKS MANAGER or FOREMAN required by large firm; must have had considerable experience in up-to-date manufacture of Graphite Crucibles, etc.; good salary will be paid to a fully competent man.—Apply, Box 740, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

AGENCIES.

AGENTS WANTED by Metallic Cement Manufacturers (well-known brand); those already calling on Ironfounders and Engineers with other lines preferred; in Newcastle and one or two other centres.—Box 726, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

SALE BY TENDER.

BY ORDER OF THE COURT.

FOR SALE BY TENDER AS A GOING CONCERN, OR ALTERNATIVELY IN LOTS.

MESSRS. JOHN CROWLEY & COMPANY, LIMITED (IN LIQUIDATION), MEADOW HALL IRON WORKS, WINCOBANK, SHEFFIELD.

THE FREEHOLD LAND and BUILDINGS, comprising MALLEABLE and CAST IRON FOUNDRIES and ENGINEERING SHOPS of over 145,000 square feet floor area.

THE FIXED PLANT and MACHINERY, THE LOOSE PLANT, TOOLS, IMPLEMENTS OF TRADE, OFFICE FURNITURE and FITTINGS, THE STORES, MATERIAL, STOCK IN TRADE, WORK IN PROGRESS, and SALEABLE STOCK.

THE GOODWILL OF THE BUSINESS, which has been established over 100 years, including patterns, models, and drawings. The Works are at present equipped with Plant capable of producing approximately 55 TONS OF MALLEABLE IRON CASTINGS AND 50 TONS OF LIGHT CAST IRON CASTINGS PER WEEK.

THE SITE AREA OF THE WORKS IS ABOUT 11 acres, part of which is available for extensions, and there is a supply of water for trade purposes from an adjoining brook. The Works adjoin and have connections with the L.M. & S. and L.N. & E. Railways and are near two stations and a 'bus route.

ALSO THE VACANT FREEHOLD TIPPING OR BUILDING LAND, comprising about 11½ acres, with extensive frontages to Newman Road and Fife Street, near the Works.

Further Particulars, including Schedules of the Fixed Plant and Machinery, etc., may be obtained from:—

Mr. J. W. Merryweather, F.C.A., Church Street, Sheffield.
Mr. G. S. Greening, F.C.A., 18, Norfolk Row, Sheffield.
} Joint Receivers and Managers.

Mr. C. Turner, F.C.A., 155, Norfolk Street, Sheffield, Liquidator.

Messrs. Webster & Company, Solicitors, 5, Leopold Street, Sheffield.

Messrs. R. Heber Radford, Son & Squire, Consulting Engineers and Valuers, 15, St. James Row, Sheffield.

PATENTS.

THE PROPRIETORS of Letters Patent No. 179847, entitled "Method of Burning Pulverised Fuel in Stationary Boilers," desire to dispose of their Patent or to grant Licences to interested parties on reasonable terms for the purpose of exploiting the same and ensuring its full commercial development in this country.

Inquiries to be addressed to CRUIKSHANK & FAIRWEATHER, Chartered Patent Agents, 65-66, Chancery Lane, London, W.C.2.

THE PROPRIETOR of British Patents No. 197804, relating to "Improvements in Pinion Housings for Rolling Mills," and No. 203009, relating to "An Improved Method of Reducing Tubes," desires to enter into negotiations with one or more firms in Great Britain for the Sale of the Patent Rights or for the grant of Licences to Manufacture under Royalty.—Inquiries to be addressed to D. YOUNG & Co., Chartered Patent Agents, 11 & 12, Southampton Buildings, London, W.C.2.

MACHINERY

One 4-ft. FOUNDRY LOAM MIXER.
One 7-in. Belt ROOTS BLOWERS, by Alldays.
One Quasi-arc Electric Welding Plant with TRANSFORMER.
Three WALL JIB CRANES with LIFTING BLOCKS.
Two SMITHS' METAL CONSTRUCTED HEARTHS.
Three RADIAL FOUNDRY GRINDERS.
For further particulars and prices, write Box 732, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

OVERHEAD HAND TRAVELLING CRANES.
One 5-ton Double Girded type, 30-ft. 6-in. Span.
One 10-ton Double Girded type, 34-ft. 6-in. Span.
One 20-cwt. Single Joist type, 26-ft. 6-in. Span.
For further particulars and prices, write Box 734, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

Two Steel CRANE LADLES; one geared; one ungeared; 15-ton capacity.
For further particulars and prices, write Box 736, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

SAND MIXERS.—New and second-hand. Ask us to quote.—W. BREALEY & COMPANY, LIMITED, Prospect Works, Hawksley Avenue, Sheffield.

MISCELLANEOUS.

LETTERS AND FIGURES for Patterns; all sizes; Aluminium; die cast, with pins in one piece; no shellac needed; simply drive them in and they cannot come off. Send for samples and prices.—A. LAKIN & SON, Totley Rise, Sheffield.

PATTERNS.—Inquiries solicited; quotations by return; shop equipped with modern machinery; quick delivery.—CLEGHORN & COMPANY, Midland Pattern Works, Spring Gardens, Worcester. Phone 264.

HAND LEATHERS.—Best Chrome Pig Skin, for handling pig-iron, etc.—Write LAWSON WALTON & Co., LTD., Newcastle-on-Tyne.

FOR SALE, about 3 tons Corebind (Liquid), and ½ ton Powder; cheap to clear.—G. M. C., 209, Malmesbury Road, Bow, London, E.3.

TILTING FURNACES.

150 lb. M.R.V. Coke-fired, NEW	£40
250 lb. MORGAN Cokefired	£48
200 lb. MORGAN Gasfired	£28
600 lb. MORGAN Cokefired	£65

I have in Stock ALL sizes of Fans and Blowers.

NEW LADLES—CHEAP.

12 Ton EVANS	£85
5 Ton McNEIL	£38
2½ Ton by GEORGE GREEN	£30
2 Ton THWAITES	£26
1½ Ton EVANS (Secondhand)	£19

BUY FROM ME AND SAVE MONEY.

ALEX. HAMMOND. *FOUNDRY MACHINERY MERCHANT,*
14, AUSTRALIA ROAD, SLOUGH.